Research Reviews

# Development and Application of Aerated Compost Teas

**Elaine Ingham, Michael Alms, and Karl Rubenberger**

In 1996, Karl Rubenberger, an organic apple and Asian pear producer, received funding from OFRF to research the effects of various substrates (molasses, kelp, rock dust and food yeast) on microorganism production, to help develop recipes for the highest quality compost teas.

As a farmer collaborator, Rubenberger worked with Elaine Ingham, Associate Professor in the Department of Botany and Plant Pathology at Oregon State University and Director of Research for Soil Foodweb, Inc., and with Michael Alms, President of Growing Solutions, Inc.

This collaborative effort produced a report, *Compost Tea Manual 1.1*, written by Elaine Ingham and Michael Alms. The full report is a comprehensive guide to compost teas. The report discusses factors involved in compost tea quality, beneficial organisms, aerobic versus anaerobic teas, various methods of making compost tea, application methods, and matching compost teas to plant and soil needs. A unique feature of this report is that it discusses matching the compost tea formulation with the crop and soil type, then gives recipes for composts with various bacteria:fungi ratios, including one high in mycorrhizae (8 recipes are given).

The following report is excerpted from the *Compost Tea Manual 1.1*.

Project coordinator:
Karl Rubenberger
Umpqua Organic Farm
Roseburg, Oregon

Co-investigators:
Elaine Ingham
Oregon State University
Michael Alms,
Growing Solutions, Inc.

OFRF support: $3,500

Project period: 1996

### Factors Affecting Compost Tea Quality

Compost tea quality can be highly inconsistent from batch to batch. Below are some of the major factors to consider. Most of them are relatively easy to control. However, when you make your own tea you will need to do some testing to make the best tea for your system.

***Compost source and quality*** Because the organic compounds, toxins, and beneficial microorganisms, as well as the pathogenic or pest microorganisms present in the compost can all be extracted into the tea, good compost is essential. If the compost is properly made, disease-causing microorganisms will be killed, out-competed, inhibited or consumed by the beneficial organisms. In order to maximize the populations of beneficial organisms, it is important that an adequate range of food resources be extracted into the tea. Minerals will be extracted from the compost as well, making it critical that the salt level not be too high, and that no toxic chemicals, or at least no high concentrations of toxins, be present.

We recommend that you ask your compost supplier to confirm the peak temperature reached during the composting process, and what oxygen concentration (or the reverse measurement, carbon dioxide concentration) was measured at that temperature. Because the heat during composting is generated by bacterial growth, the compost may become anaerobic during peak temperature times. Temperature must exceed 135° F for at least three days, although higher temperatures for 8 to 15 days are safer. The temperature should, however, not exceed 150° to 155° F and the oxygen level should not drop below 8 to 12% during this time. If compost gets too hot, does not heat enough, or becomes anaerobic, you risk making a poor tea.

***Mesh size of the tea bag*** The mesh size of the bag or filter that holds the compost determines the kind of particulate material that passes into the tea. The finer the mesh, the more likely that only soluble components will be extracted. This becomes critical when the tea will be applied through sprayers or irrigation systems. The bag or filter should be made of a material with a small mesh size. Nylon stocking, silk and fine-weave cotton are best, but window screening, wire mesh and burlap may also be used. Fresh burlap should be used with caution, though, as it is soaked in preservative materials which can be extracted into the tea.

***Brew time*** The longer the "brew" time—the time the compost remains suspended in the water, or tea solution—the greater the amount of soluble material extracted from the compost. More soluble material in the tea means more food resources to grow beneficial bacteria and fungi, and more nutrients that will potentially be made available for plants.

If the tea is well-mixed and well-aerated, maximum microorganism growth and extraction of soluble nutrients occurs within 18 to 24 hours. But it is possible to have too much of a good thing. Brewing longer can produce too much food for the bacteria, which can lead to oxygen depletion and anaerobic conditions.

***The water source*** Water high in salts, heavy metals, nitrate, chlorine, or contaminated with pathogens (human, animal or plant disease-causing microorganisms) should not be used. Where any of these are present, removal becomes a priority before using the water.

We recommend that you contact your water treatment department or send a water sample to a testing lab for analysis.

***Added materials*** Many ingredients can be added to compost tea to enhance the growth of specific microorganisms and provide micronutrients for plants. This report gives a basis for choosing some of these materials, but a great deal more work is needed to understand why some additives work in certain conditions and not in others.

***Water recirculation method*** Recirculation has two major goals: mixing and aeration.

Both of these processes need to be controlled. Too rapid mixing will physically destroy beneficial microorganisms in the tea, and be just as detrimental as no mixing. When aeration is too great, the tea can become "super-charged" with oxygen, which is detrimental to beneficial microorganisms. Too little oxygen causes anaerobic conditions, which results in materials that are toxic to plant growth in the tea (see *Aeration* below). Properly controlling recirculation produces a more consistent tea.

Proper recirculation is often a problem, as is enough mixing to extract all the soluble materials from the compost. Recirculation units are often made from recycled farm equipment, such as water troughs; wood, on which to lay a wire screen and cotton filter material; a sprayer nozzle with a water pump, and air pumps with bubblers.

***Aeration*** Oxygen is required by all aerobic organisms. As oxygen concentration is reduced, strictly aerobic organisms will not survive. Lack of oxygen allows the growth of facultative anaerobes and strictly anaerobic bacteria. Anaerobic organisms are not detrimental in themselves, but their metabolic products are extremely detrimental to plants as well as many beneficial microorganisms. Anaerobic products kill many disease-causing microorganisms, too, but the balance of reduction of disease-causing microorganisms versus negative impact on plant growth must be considered. Usually the death of a few disease-causing microorganisms is not positive enough to offset the reduction in plant growth.

***Microorganism growth in compost teas*** It is desirable to have a wide diversity of bacteria, fungi, protozoa and nematodes present in the compost and resulting compost tea. When the diversity of beneficial microorganisms is high, disease suppression is greater, nutrient retention is higher, production of plant-available nutrients occurs at a more beneficial rate, and soil aggregation improves, along with water-holding capacity, breakdown of toxic materials and decomposition rates. When the diversity of microorganisms in the compost is low, disease control is limited, and one particular set of metabolic products can accumulate to the detriment of plants and other microorganisms.

***Ratio of compost to water*** The "dilution" of soluble materials and microorganisms from the compost into the water is important. Too little compost will result in too dilute a tea. There is a minimum concentration of soluble nutrients which will result in growth of microorganisms that will suppress disease, retain nutrients, cycle nutrients into plant-available forms, perform the processes that aggregate soil, and decompose toxic materials. Because the optimal ratio of compost to water tends to be a bit variable, you will want to experiment to find the best ratio for your system.

***Environmental conditions*** Temperature, humidity, evaporation and other abiotic conditions influence the growth rate of microorganisms. For example, high temperatures volatilize nutrients. Evaporation concentrates salts, while low temperatures slow microorganism growth. Obviously, these conditions can have a significant influence on the quality of the tea.

But, you can't do much about the weather. The growth of microorganisms in the tea-maker elevates the water temperature, but as long as the tea is well mixed, temperatures will not exceed 100° to 110° F. In hot weather, covers will prevent evaporation and concentration of salt.

## The Compost Tea Recipe Table

| SOIL TYPE | PLANT TYPE: Kale Mustards | Grass Row Crops | Berries Vines Shrubs | Deciduous Trees | Conifers |
|---|---|---|---|---|---|
| Clay | A | B | C | D | D |
| Loam | A | E | C | D | D |
| Sand | E | F | G | H | H |
| Potting Mixes | A | F | G | H | H |

**Table 1**. Requirements for the tea recipe given major divisions in plant and soil types. See page 24 [of the Compost Tea Manual 1.1] for recipes. B=bacterial, F=fungal, F:B=ratio of fungal to bacterial biomass.

## The Recipes

*Eight recipes are presented in the* Compost Tea Manual 1.1. *Following are three examples*:

**A** High B Tea

***20 lbs bacterial compost***
***16 oz black strap molasses***
***8 oz soluble cold water kelp***
***1-6 oz liquid, filtered plant extract material (for example, yucca extracts, nettle soup, dandelion wine, comfrey tea)***

**B** B Tea

***20 lbs bacterial compost***
***16 oz black strap molasses***
***Optional: 8 oz soluble kelp (additional proteins)***

**C** 1:1 F:B, Fungal Foods

***20 lbs 1:1 fungal to bacterial biomass ratio compost***
***0.5 to 1 pint humic acids***
***8 oz soluble kelp***
***4 lbs rock dust***

### The Recipe Table

The exact plant you grow might not be listed in the table, so select the category that fits the plant best. A few specific examples follow. Tomatoes fall in the grass/row crop category. Strawberries, grapevines, kiwi, rhododendron, and snowbrush fall in the berry/vine/shrub category. Deciduous trees include poplar, almond, peach, citrus, coffee, apple, avocado and olive. Conifers include pines and most evergreens. It should be noted that some cedars actually fall in the deciduous category, and epiphytic plants and palms most likely fall in that category as well.❖

*A copy of the full report,* Compost Tea Manual 1.1, *(42 pp) is available from OFRF (831-426-6606). Report #96-15. Or contact Soil Foodweb at 541-752-5066.*