RESEARCH HIGHLIGHTS

VERMICOMPOST TEA PRODUCTION AND PLANT GROWTH IMPACTS

Ohio State research finds that aerating vermicompost tea during brewing results in significant growth responses, even at the lowest concentration tested.

Part I

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USE of vermicomposts, produced through interactions between earthworms and microorganisms, promote the germination growth, flowering and yields of a range of greenhouse and field horticultural crops including tomatoes, peppers, strawberries, raspberries, grapes, marigolds and petunias. Vermicompost use has become a well-established practice over the last 10 years, in part due to the work of scientists in the Soil Ecology Laboratory at The Ohio State University. Our research has demonstrated the considerable potential of vermicomposts — produced from a wide range of organic wastes, particularly cattle, pig, paper and food wastes — in suppressing plant diseases, such as *Pythium*, *Rhizoctonia*, *Plectosporium* and *Verticillium*; plant parasitic nematodes, such as soybean cyst nematodes *Heterodera* and root knot nematodes *Meloidogyne hapla*; as well as arthropod pests, such as cabbage white caterpillars, cucumber beetles, tomato hornworms, mealy bugs, spider mites and aphids.

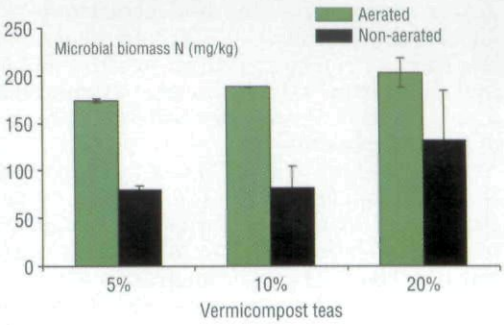
During the last two to three years, many organic and other growers wanting to minimize fertilizer and pesticide use have been experimenting with producing and using aqueous extracts of both thermophilic composts and vermicomposts. These liquids, termed "teas," are much easier to transport and apply to crops than the solid materials.

Aqueous extracts from vermicomposts are produced using a wide array of production methods. It is assumed that microbial biomass activity and plant nutrients can be transferred from vermicomposts into the teas. While a variety of methods are used to make teas, all start by mixing solid vermicompost with water. The ratio of solids to water used can range from 1:3 (33%) to 1:200 (0.5 %). Some processes are aerated and others are not; sometimes, supplemental nutrient sources, including molasses, algal powders or yeast extracts, are added to the teas in the expectation that they will increase their microbial activity and effects.

Extraction of teas from vermicomposts can take anywhere from 12 hours to as long as three weeks. Some growers produce teas in homemade equipment, but a wide range of "brewing" equipment of different capacities and efficiencies are available and becoming used increasingly.

Although vermicompost (and compost) teas are produced in very large quantities across the U.S. and elsewhere, there have been few well-developed research studies published in scientific literature relating to the best methods of production, their effects on plant growth, pests or diseases, or possible side effects. These comments apply equally to teas produced from thermophilic composts or vermicomposts. The suppression of plant parasitic nematodes and arthropod pests by vermicompost teas will appear in the December 2007 issue of *BioCycle*.

Figure 1. Effects of aeration on microbial biomass in food waste vermicomposts



METHODS OF TEA PRODUCTION

Beginning in 2003, we began preliminary research at our Ohio State laboratory into the preparation, uses and optimal application rates and methods of storage of teas produced form vermicomposts. Greenhouse plant growth trials soon established that the vermicompost teas had significant effects, not only on plant germination and growth, but also on the incidence of plant diseases, plant parasitic nematodes and arthropod pests. This research began by testing various ways of preparing vermicompost teas, aiming to define the optimal equipment, ratios and dilutions. In particu-

lar, we focused on the importance of aeration during the tea-brewing process and the extent of transmission of microbial activity, nutrients, and enzymatic activity from the vermicomposts to the aqueous extracts. Our teas were prepared from food waste vermicompost, produced in automated continuous flow reactor systems by Oregon Soil Corporation, which has been marketing food waste vermicomposts since 1990.

A range of concentrations of vermicomposts and vermicompost teas were added to soils and the microbial activity in the various mixtures was assessed. The solid treatments were 5 percent, 50 percent, and 100 percent vermicompost to soil ratios. The teas added to the soils were 5 percent and 50 percent vermicompost to water ratios (volume:volume) added to soil. Microbial activity was assessed 0, 16, 32 and 64 days after the treatments had been applied to soil. The composition, diversity and activity of the soil microbial communities was rated with a fatty acid methyl ester (FAME) technique, which used the diversity and quantities of fatty acids as biological fingerprints of microbial communities and activity. Obviously, with decreasing concentrations of vermicomposts and vermicompost teas there was less microbial activity in the teas. Nevertheless, the teas had about one-third of the microbial activity and diversity of the solid vermicomposts, volume to volume, and there was little diminution of microbial activity and diversity over the 64-day course of the experiments.

This research was followed by a study of the effects of aeration in tea brewing on key chemical and biological parameters of the teas produced, and their effects on plant growth. The volume:volume ratios of vermicompost to water used were 1:5 (20%), 1:10 (10%) and 1:20 (5%); half of the treatments tested were aerated and half were not. Parameters studied were: pH, nitrate-N, dehydrogenase enzyme activity and microbial biomass (Figure 1). All of these parameters were significantly lower in the nonaerated teas compared with those in the aerated ones, probably because dissolved oxygen supports microbial activity. Probably the most important parameter, which was not easy to assess, was the presence of plant growth regulators in the teas, which can influence plant growth significantly independent of nutrient availability. Clearly, all of the evidence obtained indicates that aeration is critical to the production of effective vermicompost teas.

Figure 2. A comparison of the effects of aerated and non-aerated 5% vermicompost teas on tomato growth in MM360 (with all needed nutrients supplied)

Figure 3. A comparison of the growth of cucumbers treated with 20% aerated vermicompost teas and 20% nonaerated vermicompost tea grown in MM360 (with all needed nutrients supplied)

Finally, the effects of a range of dilutions of vermicompost teas — ranging from 0 percent (water control), 5 percent, 10 percent and 20 percent either aerated or nonaerated — on the germination and early growth of tomatoes and cucumbers were studied in the greenhouse. Germination rates, heights and leaf areas of tomato plants were significantly greater in response to treatments with aerated vermicompost teas, than those of plants treated with nonaerated vermicompost teas (Figure 2). There were significant growth responses to aerated vermicompost teas, even at the lowest concentration tested (0.5%). Similar responses occurred in germination, heights and leaf areas of cucumbers in response to aerated and nonaerated teas (Figure 3). No practical problems such as adverse growth effects in the use of vermicompost teas were found at any of the dilutions tested. ■

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PATHOGENS AND COMPOST TEAS

IN 2004, the Compost Tea Task Force was charged by the National Organic Standards Board to review the potential for contamination of teas by human pathogens. Vermicompost teas were included in this review. Members of the Task Force concluded that when additives such as carbon substrates like molasses or sugars were added to teas to encourage the growth of beneficial nonpathogenic microorganisms, the populations could also increase the growth of bacterial human pathogens from undetectable to harmful numbers in some investigations. This would be a particular hazard if compost teas prepared from composts produced from animal wastes were sprayed on food crops close to harvesting. The Task Force concluded that if thermophilic composts were prepared according to U.S. Environmental Protection Agency guidelines, with temperatures maintained above 55°C for more than 72 hours before using them for tea production, this risk would be greatly decreased.

Similarly, there is increasing evidence in scientific literature and from research by the authors of this article and their colleagues, that human pathogens are eliminated from organic wastes by vermicomposting for more than 50 days. Clearly there are good reasons for caution about this aspect of preparing and using compost and vermicompost teas.

Further reading on this topic can be found in the literature. Below are several literature citations:

Eastman, B.R., Kane, P.N. Edwards, C.A., Trytek, L., Gunadi, B. 2001: The effectiveness of vermiculture in human pathogen reduction for USEPA Class A Stabilization. *Compost Science and Utilization* 9, (1). 38-49.

NOSB. (2004). "National Organic Standards Board: Compost Tea Task Force Final Report." Retrieved July 8, 2004, from http://www.ams.usda.gov/nosb/meetings/CompostTeaTaskForceFinalReport.pdf

Ingram, D.T., Millner, P.D. 2007. Factors affecting compost tea as a potential source of *Escherichia coli* and *Salmonella* on fresh produce. *J. Food Protection* 70: 828-834.