RESEARCH TRIALS

# EFFECTS OF VERMICOMPOST TEAS ON PLANT GROWTH AND DISEASE

*Beneficial response may be due to plant growth regulators or hormones produced by the high microbial activity in vermicomposts.*

*Clive A. Edwards, Norman Q. Arancon and Scott Greytak*

THERE is an urgent need to standardize compost and vermicompost tea production methods and application rates as far as possible to increase their effectiveness, avoid adverse effects and decrease human and environmental potential hazards. Most of the evidence on their effectiveness in plant growth enhancement or disease suppression is anecdotal. There have been few well-designed experimental trials or scientific reports that assess their effectiveness or focus on finding optimal production methods or application rates. There are also very few reports on possible mechanisms by which they promote plant growth or suppress plant diseases.

***Figure 1. Germination of tomatoes to the seedling stage in response to vermicompost tea applications in the greenhouse***

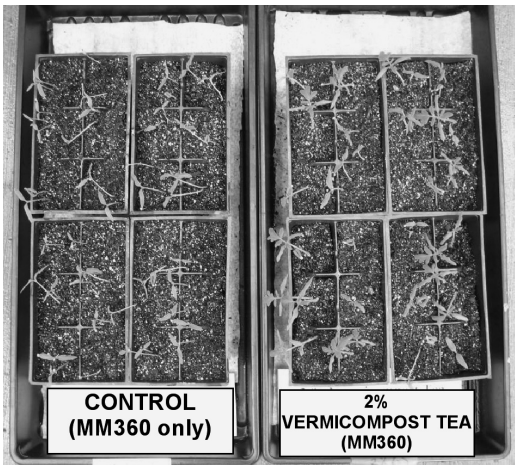



***Figure 2. Growth of tomatoes after six weeks in response to regular vermicompost tea applications to plants growing MM360 in the greenhouse***

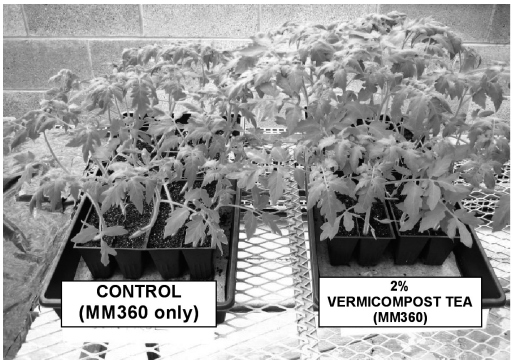
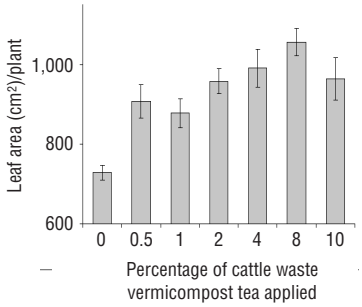



***Figure 3. Growth of tomatoes measured in terms of leaf area in response to regular vermicompost tea applications to plants growing in MM360 in the greenhouse***




## PRODUCTION OF VERMICOMPOST TEAS

Until recently, our research at Ohio State University has addressed primarily the effects of solid vermicomposts on plant germination and growth and the suppression of plant diseases. During the last year, we have extended our research into similar studies of the effects of aqueous vermicompost extracts or teas on plant growth and plant diseases. Preliminary research has demonstrated clearly that teas produced with aeration are much more stable and effective than those produced without aeration. The teas were produced by standing 1 liter of vermicompost in 4-liters of aerated water for 24 hours before draining it off and placing it in containers for use in greenhouse trials. We produced a range of dilutions with tap water before testing them on the germination and growth of test plant species in the laboratory and greenhouse.

For the actual trial, the effects of a range of concentrations of teas produced from cattle waste vermicomposts were tested on the germination and growth of tomatoes. All plants (control and with tea applied) were grown in a soil-less bedding medium (Metro Mix 360). In addition, all of the treatments received saturation amounts of nutrients. All of the concentrations used, down to even as low as 0.5 percent, increased the germination and growth of tomato plants significantly over that in the MM 360 with no tea applications (Figures 1, 2 and 3). In the first

Preliminary research demonstrates that teas produced with aeration are much more stable and effective than those produced without aeration.

set of experiments, vermicompost teas were prepared with a dilution range of 0.5 to 10 percent. Teas were applied to tomato trays at transplanting, and then twice weekly for eight weeks. Fresh teas were prepared for each application.

### EFFECTS ON GERMINATION AND GROWTH

Several possible mechanisms could explain the increases in growth of tomatoes. Teas from vermicomposts could possess some of the same beneficial microbiological and chemical characteristics of solid vermicomposts. During the "brewing" process, soluble mineral nutrients, beneficial microorganisms, humic and fulvic acids, plant growth hormones and plant growth regulators — known to be available in solid vermicompost — are probably extracted into the tea. These probable beneficial components could be the key factors that affect plant growth positively. Although mineral nutrients may be present in vermicompost tea, these could not be the main reasons for increases in growth, since all of the tomato plants received all necessary nutrients. This leaves microorganisms and plant growth regulators such as hormones, humic acids and fulvic acids as the most probable mechanisms for growth increases of tomatoes.

In the past, we have demonstrated conclusively in several greenhouse experiments that humic acids extracted from vermicompost can affect plant growth positively. Small amounts, ranging from 250 to 500 mg dry humic acids per kg of a commercial growth medium (MM360) were sufficient to produce significant increases in growth of tomatoes, peppers, marigolds and strawberries. Additionally, humic acids from vermicomposts produced superior growth compared with commercial humic acids when applied at the same rate. Plant growth hormones, such as auxins, that could be dissolved during the brewing period maybe responsible for the increases in growth. The tomato plants could have benefited from either growth hormones or from hormones that had been adsorbed onto humic acids during vermicomposting being passed into the teas. Since microorganisms could pass into the teas during brewing, they could also have multiple benefits on the plants.

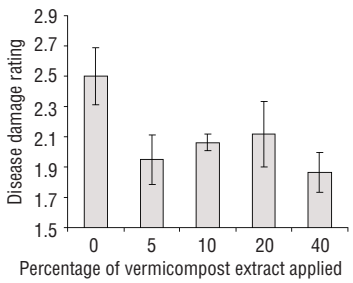
### PLANT DISEASE SUPPRESSION

We know much more about the effects of solid composts and vermicomposts on the incidence of plant diseases than the effects of teas produced from composts and vermicomposts. There are many reports in the literature of suppression of plant diseases by traditional thermophilically-produced solid composts. Possible mechanisms for disease suppression by composts that have been suggested include a general suppression of pathogens based on competition by pathogens and other microorganisms for nutrients and energy. More specific suppression mechanisms may be due to antagonisms between pathogens and other microorganisms, competition for pathogen infection sites, or destruction of pathogen propagules such as spores.

Recent research in our laboratory has demonstrated clearly that solid vermicomposts also can suppress a range of plant diseases such as *Pythium* on radishes and *Rhizoctonia* on cucumbers in the greenhouse. In addition, low field application rates of vermicomposts suppressed *Verticillium* wilt on strawberries, *Phomopsis* and powdery mildew on grapes and bacterial rot on cucumbers. The suppression was clearly microbial since suppression properties of vermicomposts were lost after sterilization of the vermicomposts.

In more recent experiments, we applied a range of dilutions of teas produced from cattle waste vermicompost, to tomato plants infected with *Verticillium* wilt and assessed the damage ratings after 14 days (Figure 4). All of the application rates of teas that were tested suppressed this plant disease significantly. If a broad range of microorganisms from vermicomposts pass to teas, their applications into a disease-infested planting medium or soil could suppress pathogen attacks by the mechanisms.

***Figure 4. Suppression of Verticillium in tomato plants by the application of cattle waste vermicompost teas to the foliage***




### CAUTIONS AND POSSIBLE PROBLEMS

There may be potential human or environmental hazards from vermicompost teas, particularly those prepared from animal wastes, due to the human pathogens such as coliform bacteria, *Salmonella*, human enteric viruses, and helminth ova that they could contain. This hazard could be multiplied if carbon substrates such as molasses or sugars were added during their preparation. Such teas applied to soils as plant growth stimulants or to suppress root diseases would probably present few human hazards, but they certainly would if used as foliar sprays on edible crops. As such, this should be avoided at all costs, as has been recommended by the Compost Tea Task Force Report to the National Organic Standards Board (www.ams.usda.gov/nosb/meetings/compostTeaTaskForceFinalReport.pdf).

Another factor to take into account is that the effects of vermicompost teas on plant growth almost certainly may be due to plant growth regulators (PGRs) or hormones produced by the high microbial activity in vermicomposts. Low application rates of PGRs usually promote plant growth, but higher application rates can actually depress plant growth, so it must be ensured that the dilutions used are tested critically to avoid such adverse effects. ■

*Clive Edwards, Norman Arancon and Scott Greytak are with The Soil Ecology Laboratory at The Ohio State University in Columbus (www.biosci.ohiostate.edu/~soilecol/).*

Reprinted From:
May 2006
BioCycle
THE ORGANICS RECYCLING AUTHORITY
63 S. Seventh Street, Emmaus, PA 18049-3755
610-967-4135 • www.BioCycle.net