

# INVESTIGATIONS INTO LIQUID COMPOST EXTRACTS

*The many variables in making and using compost teas to control plant pathogenic fungi are explored in this review.*

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Before making tea, compost is evaluated by Richard Brinton, Woods End UK (above). Alan York of Golden Hooves Farm in Boonville, California sieves compost tea into a spray tank (right).

The potential disease suppressive characteristics of composts are becoming well recognized, and the subject is receiving increasing scientific research. New interest is also evident in the use of liquid extracts of compost for disease control. These compost teas — also called watery compost extracts — should not be confused with use of leachates collected from compost sites, although the latter may also possess nutrients and fungicidal properties. They also should not be equated with compost humic extracts, compost microbial starters and other similar preparations. As understood in this report, which discusses potentials and pitfalls, compost teas refer to a more deliberate production of specific extracts based on composts of known properties and age.

Use of compost extracts differ significantly from reported use of solid compost in container media to suppress damping off and root fungal diseases. Watery compost extracts are applied directly to plant surfaces via conventional high pressure spraying apparatus. Extracts act directly in varying degrees to suppress both the germination and growth of plant pathogenic organisms and are efficacious for short periods of time.

A number of serious agricultural problem areas exist which are possible candidates for applications of compost extracts. These are

chiefly where fungal diseases start and spread from leaf and stem surfaces. Examples are apple scab, mildew on grapes, and late blight in potato culture.

## MODE OF EFFECTS OF COMPOST EXTRACTS

Compost teas exert influence on plant surfaces (phyllosphere) through a coating with actual live bacteria. The principal agents in the compost extracts appear to be bacteria representing but not necessarily limited to the genera of *Bacillus*, *Pseudomonas*, *Serratia*, *Penicillium*, and *Trichoderma*. In examining normal composts, we have found that the majority of bacteria in moderately mature materials are facultative anaerobes or aerobes. Species such as *Enterobacteria*, *Serratia*, *Nitrobacter*, *Pseudomonads*, *Bacillus*, *Staphylococcus* and various *Actinomycetes* are all present. It seems likely that many composts possess potential disease suppressive traits.

There is no single mechanism explaining effects of compost extracts against pathogens. To date, the effects of compost extracts have been divided into several categories: Inhibition of spore germination; Antagonism and competition with pathogens; and Induced resistance against pathogens.

The primary source of the effects observed with compost teas is apparently of a live, microbiological nature. Sterilized or micron filtered compost extracts usually exhibit significantly reduced activity against pathogens. This does not rule out that in some cases sterile extracts will possess suppressive effects.

Based on existing information, it is clear that successful use of compost extracts for disease control needs to be evaluated in relation to specific cultivars and specific fungal pathogens. In many reported cases, pathogens have been controlled by compost teas to levels similar if not better than conventional fungicidal treatment. However, the findings also suggest that different



modes of preparation of the watery compost extracts may be required to satisfactorily treat different diseases under varying field circumstances.

#### **FOUR STEP APPROACH TO MAKING COMPOST EXTRACTS**

There are four stages in the process of making compost teas: preparation, extraction, filtration and induction. Each stage has a few specific conditions.

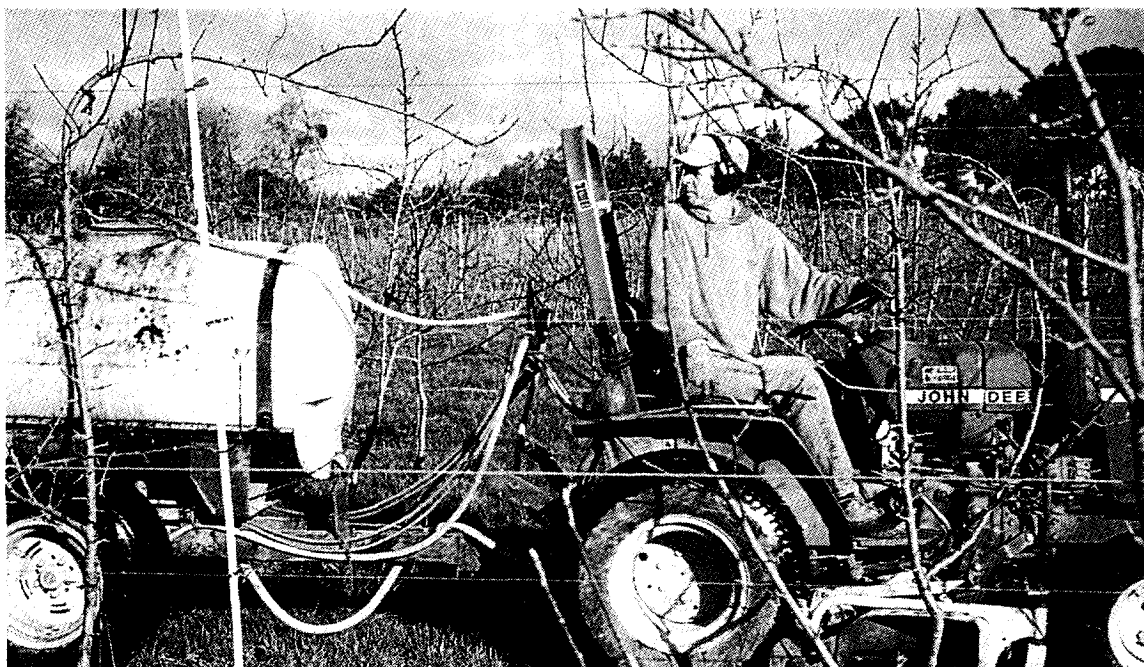
1. *Preparation Stage:* Fresh compost is blended with tap water in a dilution ratio of 1 part: 5-10 parts (vol/vol). The ideal ratio must be experimentally derived. Wooden barrels or large tanks are preferred. To be avoided are pesticide/biocide tanks even if previously washed.

2. *Extraction:* Allow to stand at 15-25°C, over 3-8 days, stirring 2-3 times during this period. A highly aerobic mix is *not* required. Stirring is performed either with a rod or rotating bar, or any kind of pumping agitation,

**Compost tea being spray misted on crops at Golden Hooves Farm (right and below).**



The most significant factors for compost tea effectiveness are the age of the compost and the nature of its source ingredients.



for about 30 minutes at each event, during the life of the extract.

3. *Filtration:* The best approach is to decant from part way up from the bottom of the tank and pass through a 200 mesh (75-micron) sieve. Determine in advance the operational spray rig nozzle sizing so that clogging does not occur. To avoid serious filtration problems, do not stir mixture within 8 hours of filtering.

4. *Induction:* Apply the extract periodically at or prior to the times of fungal infection pressure using conventional plant protection spraying equipment. It is highly advisable to add a wetter/sticker agent, but it must be prescreened for antimicrobial properties using a standard microbial challenge procedure.

Assuming all the proper steps are taken,

the most significant factors influencing the effectiveness of watery compost extracts are considered to be the age of the compost itself and the nature of the source ingredients which go into it. It should be noted that some wetter-sticker (surfactant) agents commonly used with fungicides have been found to be microbially suppressive, spoiling the effects intended for the compost teas. (Woods End Lab in Mt. Vernon, Maine and other microbial labs like BBC Laboratories in Tempe, Arizona offer a screening service to pretest these agents.)

#### **FARM AND COMMERCIAL COMPOSTS COMBAT FUNGAL DISEASE**

Both farm and commercial agricultural composts possess qualities that may lend themselves to disease suppression. Given

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the ability of many farmers to produce their own, and the likelihood that some of these composts may already possess fungicidal properties, then more widespread use for biological control is within sight. However, farms deprived of livestock may be the most in need of microbiologically rich composts.

While the theory of compost tea disease control is easy to grasp, it is operationally more difficult. The heterogeneity of compost source materials and the lack of stability or relative immaturity of many commercial composts is likely to limit the usefulness of this approach. If compost leachate is substituted for prepared compost teas, there is no guarantee that it will possess the same properties as a prior batch. Even given a good compost, the improper handling or poor timing of applications could frustrate growers' efforts to achieve success in the field. Thus, the need exists to define the qualities that make for high value composts and to determine the means of preparation and application needed to achieve consistent field effects. (In Europe, emphasis is on the use of the Dewar Flask method to determine relative age of the compost.) In one study, we determined the efficacy of differently aged horse manure compost against *Fusarium* wilt of clover seedlings and found 8-week old product was significantly superior to 20 week product.

a relationship to pH or other chemical traits, and is definitively associated with facultative anaerobes more than strict aerobes and can be dependent on the nature of the compost substrate.

#### SOLID COMPOST VS. LIQUID EXTRACTS

In addition to compost teas, there is considerable basis for soil applications of macro amounts of finished compost. Compost is well known for imparting suppressiveness directly to the soil. In addition, trials have shown significant differences in antipathogenic effects between composts, green manures and livestock manures. In one study, soils receiving composts over three years showed increasing antipathogenic traits against *S. trifoliorum*, with some instances of 100 percent control. Soils receiving fresh green waste and non-composted livestock manures over the same period in contrast gave no pathogen reduction. In other words, use of solid compost applied directly to soils or container media should not be curtailed even when compost teas are available.

The difference between the use of soil applied composts and watery compost extracts can perhaps best be summarized in that the teas give immediate but very short term control of surface spreading pathogens, while soil composts act more slowly over a longer period of time and require much larger amounts. For long-term effects in solid media, it is not unusual that at very least five percent by volume and often as much as 40 percent compost in the seedling mix are required to bring about effective disease control. In contrast, a whole hectare of vineyard can be covered with extract prepared from less than 100 kilos of compost.

Seed dips with manure composts have long been advocated by biodynamic farmers in Europe. Current research shows the suppressive effects of the teas as dips are apparent with control of *Pythium* on alfalfa. It is clear that increased use by farmers of seed baths should and could be made as a substitute for conventional seed coatings with questionable fungicides such as Captan.

These and other results underscore the significant effects that properly prepared teas can achieve when used in substitution for, or in conjunction with, standard fungicide control programs. Increased research and trials in the field are likely to promote this "value added" composting on an even broader scale in agriculture. ■

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Compost of varying organic materials such as leaves, yard trimmings and straw, can show varying disease suppressiveness, with a loss of the ability after as little as three months of aging. Composts containing manures (horse and dairy) have shown significant antifungal properties in some cases up to 9-12 months of age.

Preservation of compost tea effects is problematic, since they must be used within one week or less of the extraction. However, in one set of studies, the antipathogenic effectiveness was lengthened through drying the compost prior to storage and the natural fungicidal properties were elicited later after remoistening. The disease suppression characteristics of compost teas has so far not been considered to have



A control grape leaf (right) infected with downy mildew (*Plasmopora viticola*) is shown next to a leaf treated with compost tea.