

## Compost Teas and Crop Quality in Nursery Stock®

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**Compost teas and extracts are defined and their effects on the health of crops are examined with examples from recent scientific literature. Available information on the safety and efficacy of compost teas is discussed and priorities for research to develop safe effective compost teas for use in crop production systems are outlined.**

### INTRODUCTION

Sprays based on compost extracts have been used for hundreds of years, but interest in them waned when pesticides became available in the 20th century, since pesticides tend to give better, more reliable control of most foliar diseases. Recently there has been renewed interest in compost extracts and teas as growers and their customers want more sustainable crop production methods and are using more "natural" products to stimulate better plant growth; while there are also a number of well-known problems relating to availability and use of pesticides.

Most work to develop improved methods for preparation and use of compost extracts and teas has been done in the U.S.A., much of it by commercial companies rather than independent institutes. This work and the key findings from it are discussed in this paper.

**Definition of Compost Teas and Compost Extracts.** Exact definitions of compost teas and compost extracts vary. The term compost tea is used here to describe the product of re-circulating water through loose compost or a porous bag or box of compost, suspended over or within a tank with the intention of maintaining aerobic conditions. It is important to distinguish between compost teas prepared using aerated and non-aerated processes, therefore the terms aerated compost tea (ACT) and non-aerated compost tea (NCT) will be used in this paper to refer to the two dominant compost fermentation methods. The ACT will refer to any method in which the water extract is actively aerated during the fermentation process. The NCT will refer to methods where the water extract is not aerated or receives minimal aeration during fermentation apart from during the initial mixing.

The term compost extract has been used in the past to define water extracts prepared using a very wide range of different methods (Scheuerell and Mahaffee, 2002). For the purposes of clarity in this paper, the term compost extract refers to the filtered product of compost mixed with any solvent (usually water), but not fermented.

## POTENTIAL EFFECTS OF COMPOST TEAS AND EXTRACTS

Compost extracts/teas have been shown to help prevent or control a wide range of foliar diseases in glasshouse and field grown edible and ornamental crops (Scheuerell and Mahaffee, 2002). Examples of diseases controlled in this way are shown in Table 1. Control has not been achieved with all pathogens in all tests and efficacy of compost teas varies depending on the crop and experimental system.

Most of the published evidence to demonstrate control of foliar disease concerns NCTs or compost extracts. There is a shortage of data on the efficacy of ACTs and few studies have compared the efficacy of ACTs and NCTs in controlling foliar diseases. The few trials, which have been carried out, have shown that the effects of ACTs vary considerably. For example, no effect of ACT applications was observed on early blight of tomato; lettuce drop (several pathogens) was reduced in a summer but not a spring crop; post-harvest fruit rot of blueberries was significantly reduced, but this was offset by reduced yields. The impact of ACTs on plant health and crop yield can therefore be crop specific and may depend on the experimental system and environmental conditions. One cannot therefore make general statements about the efficacy of ACTs.

**Table 1.** Examples of plant disease suppression in the field following application of compost teas or extracts made from known feedstocks.

Target pathogen	Disease	Crop	Main feed stocks in compost
<i>Alternaria solani</i>	early blight	tomato	cattle manure
<i>Botrytis cinerea</i>	grey mould	strawberry	horse manure; cattle manure
<i>Diplocarpon rosae</i>	black spot	rose	waste fruit
<i>Pseudomonas syringae</i> pv. <i>maculicola</i>	leaf spot	arabidopsis	pine bark
<i>Sphaerotheca pannosa</i> var. <i>rosae</i>	powdery mildew	rose	chicken manure
<i>Uncinula necator</i>	powdery mildew	grape	horse manure, straw, soil
<i>Venturia inaequalis</i>	apple scab	apple	SMS; manure, straw, soil
<i>Xanthomonas vesicatoria</i>	leaf spot	tomato	several (incl. Hardwood bark)

Compost teas are also being widely advertised and used on both organic and conventional nurseries in the U.S.A. as an inoculant to restore or enhance soil microflora <[www.attra.ncat.org](http://www.attra.ncat.org)>. However very little work has been done to establish the effectiveness of teas used in this way or to quantify the benefits, if there are any.

NCTs have been shown to reduce the impact of seedborne pathogens when used as a seed treatment (Tränkner, 1992). Compost teas have also been shown to affect soilborne pathogens *in vitro*, but it is well known that successful disease control *in vitro* does not always translate to field conditions. Recent work has shown that fusarium wilt of pepper (*Fusarium oxysporum* f.sp. *vasinfectum*) and cucumber (*F.*

*oxysporum* f.sp. *cucumerinum*) was controlled by drenching NCT on to soil under greenhouse conditions (Ma et al., 2001).

### MODE OF ACTION

Compost teas sprayed onto plant leaves act on the leaf surface. The principal active agents in compost teas are bacteria in the genera *Bacillus* and *Serratia*, and fungi in the genera *Penicillium* and *Trichoderma*, although other genera are involved (Brinton et al., 1996). It is thought that compost extracts/teas act in three main ways: through inhibition of pathogen spore germination, through antagonism and competition with pathogens, and through induced host plant resistance against pathogens. The effects of compost extracts/teas largely depend on live microorganisms. Sterilised or micron filtered compost extracts have usually been shown to have significantly reduced activity against test pathogens.

### PREPARATION AND USE

The production of ACTs and NCTs involves compost being fermented in water for a period of 1 to 5 days. Both methods require a fermentation vessel, compost, water, incubation, and filtration prior to application. Nutrients may be added prior to or following fermentation and additives or adjuvants may be added prior to application. Several companies now sell fermentation units that produce aerobic compost tea by suspending compost in a fermentation vessel and aerating, stirring or recirculating the liquid.

Several hundred commercial growers including producers of ornamentals, field vegetables, and glasshouse crops in the U.S.A. and the Netherlands are making compost teas and spraying them onto foliage as plant strengtheners and/or to help prevent foliar disease. However, compost teas are currently very little used and little understood in the U.K. At present, around 30 U.K. growers of ornamental crops and a small number of organic producers are experimenting with compost teas on their own nurseries and farms.

### POTENTIAL PROBLEMS WITH THE USE OF COMPOST TEAS

The main potential problem with compost teas (apart from reports of variable efficacy in preventing or controlling plant disease) is the concern that fermenting compost could potentially support the growth of human pathogens. For example, Welke (1999) detected faecal coliform and salmonella populations in the source compost, the NCT fermentation, and on samples of broccoli and leek growing in a field and sprayed with the NCT. Pathogens have been shown to grow during the production of both ACTs and NCTs. However, the indications are that pathogen growth is not supported when ACTs or NCTs are prepared without fermentation nutrients (Scheuerell and Mahaffee, 2002). Further work is required to ensure that the production and use of compost teas and extracts can be guaranteed not to propagate and spread human pathogens onto food intended for human consumption.

### THE FUTURE FOR COMPOST TEAS IN UNITED KINGDOM AND IRELAND

Growers of ornamental crops in the U.K. and Ireland must maintain and improve crop quality in the face of increasing pressure to reduce pesticide use and a gradual decrease in availability of effective pesticides. There is some evidence that the use of compost extracts/teas can help them do this through direct and indirect control of pests and diseases.

Considerable work is required to ensure predictable disease suppression and control from compost teas for different crops in different climates and soils. Much of the current work has been done, or is being done in the U.S.A. on different crops and in very different climates, soils, and farming systems from those in the U.K. and Ireland. It is necessary to develop the techniques and protocols successfully developed in other countries for use in U.K. and Irish organic farming systems.

Work relating to compost teas is still in the early stages, although several consultants and farmers (both conventional and organic) in the U.S.A. and Europe are claiming improved crop quality and health and in some cases disease prevention and control based on significant anecdotal evidence. Work is now being done in the U.K. under the auspices of the Horticultural Development Council (HDC project HNS125) to optimise the use of compost teas in the production of hardy ornamentals.

This work will examine the effects of compost teas on lavender and choisya, although other crops are being looked at where possible. Much of the recent U.S.A. work has been carried out using teas made from feedstocks, which are not readily available in the U.K. Horticultural Development Council funded work is now assessing the quality and disease suppressive properties of composts made from feedstocks which are readily available in the U.K. Most U.K. ornamentals growers are currently using compost from a single, Dutch source. While this appears to be of excellent quality, work needs done to examine the nature of this compost and to determine alternatives, in case this supplier ceases to exist or increases the price beyond that which makes its use economically viable.

The HDC project will address several other issues including optimisation of the brewing process and the effects of using compost teas as part of an integrated crop protection strategy. Further fundamental research will be required in future to gain a more detailed understanding of the mode(s) of action of compost teas. This may also allow the combination of other natural products and biological agents to treat organic crops.

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