
**ORGANICS FACT SHEET**
**MAY 2006**

## COMPOST AND DISEASE SUPPRESSION

Now that larger volumes of compost are being generated in Scotland, the many benefits that composts possess are being more widely illustrated and documented. Although composts are primarily used as soil ameliorants, to improve soil quality, they also provide nutrients (fertiliser benefits) and can control a variety of plant diseases (fungicidal activity). The biological control of diseases, especially soil borne diseases, has been documented as far back as the 1950's in the US and Australian nursery industries.

Worldwide research has progressed over the years to show that biological disease suppression works with a variety of composts (including garden waste derived compost), both within the greenhouse and out in the field, on nursery, landscape, and turf species, as well as a variety agricultural crops.[1,2] Research funded by WRAP in the UK[3] has illustrated biological disease suppression with a variety nursery grown plants (e.g., *Xanthomonas* control on Ivy, Leaf Spot control on *Photinia*) using garden waste compost. In England, DEFRA (Pesticide Safety Directorate) has essentially confirmed the fact that certain composts possess disease suppressive characteristics, as they allow composters to place the following "claim statement" on their product label: *"This product in not a pesticide. However, it contains low levels of naturally-occurring soil micro-organisms which may help to suppress soil-borne populations of some plant diseases."*

Obtaining the biological suppression of diseases through compost use has important economic implications, as it can reduce the management costs of specific ornamental plant and crop species through the reduction or elimination of pesticide use. Further, many pesticides (fungicides) are only effective for a matter of days or weeks, whereas biological disease suppression through an improved soil health may work for months. This would equate to great savings in both pesticide costs, as well as the labour associated with its application, and does not even consider worker health and environmental benefits.

### Mechanisms in Disease Suppression

Research has identified the primary mechanisms by which certain composts suppress diseases, and these mechanisms are listed below. However, certain facts should be understood about compost and disease suppression.

1. Composts are primarily used in preventative, not curative situations,
2. Composts do not typically eliminate the disease organisms, but reduce their population, thereby minimizing or eliminating their negative economic impact (sometimes, composts do not even kill the pathogen, but suppress their activity),
3. Application of immature composts or raw organic feedstock (e.g., manure) can actually increase the population of disease organisms.

Biological disease suppression is typically described to be effective by way of 'general' suppression or 'specific' suppression. General suppression is when the collective pool of microbes in the substrate 'competes with plant pathogens for carbon, energy and nutrients like nitrogen.'[4] Therefore, 'no single organism alone is responsible for general suppression.'[5] 'Specific suppression occurs through the activities of one or several specific populations of organisms', whereas one or more specific micro-organisms are antagonistic to the plant pathogen during some phase of the pathogen's life cycle.'[6] General suppression is what most commonly occurs.

There have been several mechanisms identified which affect biological disease suppression, but more recently, this list has been honed down to four major mechanisms:

1. ***Antagonism*** – this refers to the ability of specific beneficial microbes to produce antibiotics which can kill pathogenic organisms,
2. ***Competition for nutrients (and energy)*** – in many cases, pathogenic organisms are poor competitors in relation to beneficial microbes. In this case, beneficial microbes populate the substrate and cause stress on the ungerminated disease spores by consuming the nutrients and energy found innately in the substrate,
3. ***Competition for root colonization*** – this is pertinent with diseases that attack plant roots. Some beneficial microbes have the ability to colonize on the plant's roots before the pathogenic organism can do so, thus protecting them,
4. ***Induced systemic resistance (ISR) or systemic acquired resistance (SAR)*** – this is a mechanism whereas disease-repressive genes in the plants are activated enabling the plant to better fend off the disease causing organism.

It should be noted that in most cases, 'there is no single mechanism controlling plant diseases in any given plant growing system; rather several mechanisms operate concurrently to suppress plant diseases.'[7] The four major soil borne pathogens that effect the nursery, turf and agricultural industries have been controlled through biological disease suppression with compost, they are:

- ***Fusarium,***
- ***Phytophtera,***
- ***Pythium, and***
- ***Rhizoctonia.***

Many other pathogens and multitude of subspecies could be added to this list. Further, research has been able to specifically identify which microbes cause antagonistic effects on disease causing pathogens. Table 1 illustrates examples of both the pathogen and the antagonistic microbe assisting in biological control.[8]

| Known biological controls of turfgrass disease | |
|---|---|
| **Disease (Pathogen)** | **Antagonists** |
| *Rhizoctonia solani* | *Laetisaria spp.* |
| *Sclerotinia* | *Enterobacter spp.*<br>*Fusarium spp.*<br>*Glioeladium spp.* |
| *Typhula* | *Trichoderma spp.* |
| *Pythium* | *Enterobacter spp.*<br>*Pseudomonas spp.*<br>*Trichoderma spp.* |
| *Fusarium* (Snow mould) | *Typhula spp.*<br>*Trichoderma spp.* |
| *Laetisaria* (Red thread) | *Complex mixtures of enterobacteria* |

***Table 1***

**Variables in Biological Disease Suppression**

There are many variables that affect the degree and duration of biological disease suppression that takes place when compost is used. Variables include the type of compost feedstock, composting process temperatures, types of microbes that colonize the compost, soil/media characteristics, and compost characteristics (level of stability, salinity, nutrients). Stable composts that are relatively low in soluble salts and ammonia are found to be more disease suppressive. In Scotland and the UK, it is feasible that green composts may provide disease suppression for one to two years 'in the field'.

There are clear economic benefits in biological disease suppression through compost usage. It is both inexpensive, as disease suppression is often seen as a free benefit that is innate within the compost, and in many situations can be long lasting. Further, many pesticides are being taken off the market, reducing the arsenal of effective products that can be used, and some individuals have health concerns pertaining to their usage. Also, more recent research has shown that compost can even be effective in controlling nematodes (microscopic worms that attack plant roots), some foliar diseases and may antagonize specific insects.

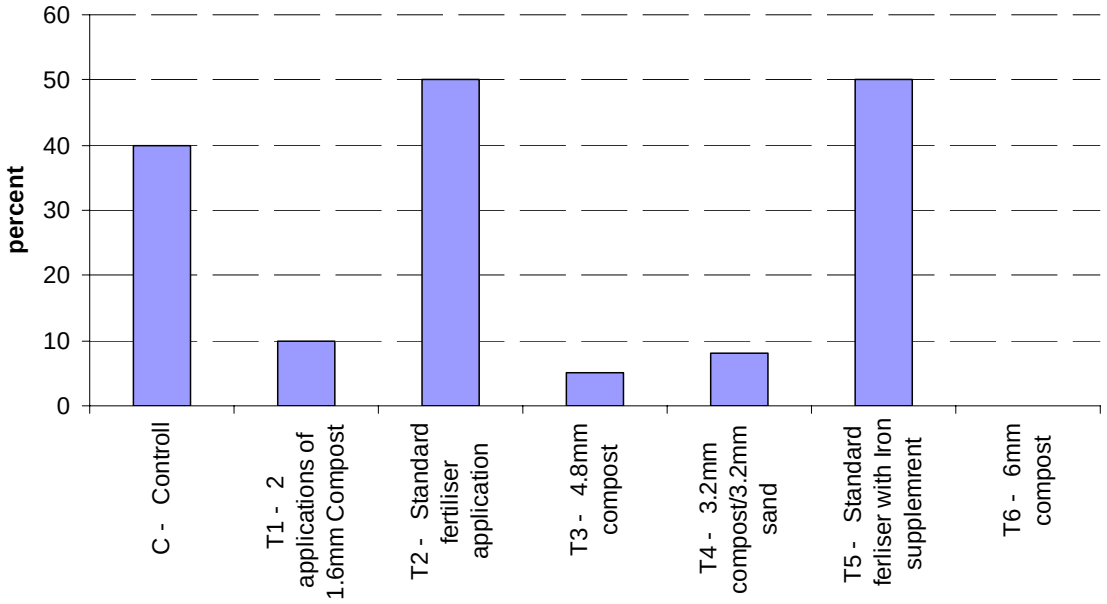
**Scottish Trial of Disease Suppression using Garden-derived Compost**

On 12th July 2004, Remade Scotland commenced an 18-month trial to monitor turf improvement from the application of compost on Pitch number 2 of Dundee and Perth Polo Club, Perthshire Racecourse in the grounds of Scone Palace. The aim of the trial was to generate sufficient information to provide an indicative quantification of the benefits of using compost as part of turf management practices.[9]

The polo pitch regularly suffers from ***Fusarium*** (snow mould) and ***Red Thread***. In previous years this had required 2 annual treatments of fungicide to suppress disease growth. However, during the first winter of the trial, no applications were made to assess the disease-deterrent actions of the various topdressings.

The incidence of disease was monitored at 9 months following the application of the treatments. It was found that in the control plots 40% of grass plants were infected with either one or both fungi whilst the fertilised plots suffered a 50% infection rate (in both the fertiliser alone and the fertiliser with iron supplement topdressings). In the composted areas, the 2 applications of 1.6mm compost suffered a 10% infection rate; the 3.2mm compost / 3.2mm sand had about 8% disease; 4.8mm compost suffered 5% infection; whilst the 6mm compost was completely disease free.

**Incidence of Fungal Infection 9 months after topdressing application**




In this trial, chemical fertilisers were shown to have a degrading effect on the resistance to disease of the turf when compared to controls.

The Scottish landscaper, nurseryman, turf manager, farmer, etc. will obtain ongoing financial benefit from the use of compost and creating a healthy soil. The beauty of its use is that you only have to pay for it once.

## Bibliography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[4,5,6,7] **H.A.J.Hoitink,** (Professor Emeritus, Dept. of Plant Pathology, The Ohio State University). 2006. Personal conversations and unpublished works.

[8] **E.B. Nelson,** *Biological Control of Turfgrass Diseases*. Cornell University Cooperative Extension, Information Bulletin 220 (winter 1992)

[9] **Remade Scotland,** *18 Month Trial at Dundee and Perth Polo Club, Perthshire Racecourse, Scone Palace to Monitor Variations in the Quality of Sports Turf Pitches Resulting from the Application of Various Topdressings.* Remade Scotland, January 2006. www.remade.org.uk


***Other Resources***

Many papers and articles by Dr. Harry Hoitink, Dept. of Plant Pathology, The Ohio State University

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