Compost teas often a 'feel-good' input rather than a necessity in most soils


Gerhard Grasser recommends application of good-quality compost or other organic matter as a source of food for micro-organisms before applying any compost teas.

By Jillian Staton

Most farmers know that compost is good for soils, but can compost teas, by extension, deliver the same benefits? And if they are beneficial, how can farmers be confident about the cost effectiveness of using compost teas in favour of more conventional inputs?

The short answer is that well made compost teas can stimulate soil biological activity in nutritionally and possibly physically degraded soil, resulting in an increase in plant available nutrients. This, in turn, may result in a quite sudden and noticeable 'burst' in plant growth and/or vigour. However, the biological activity will only last as long as there is a food source for the micro-organisms.

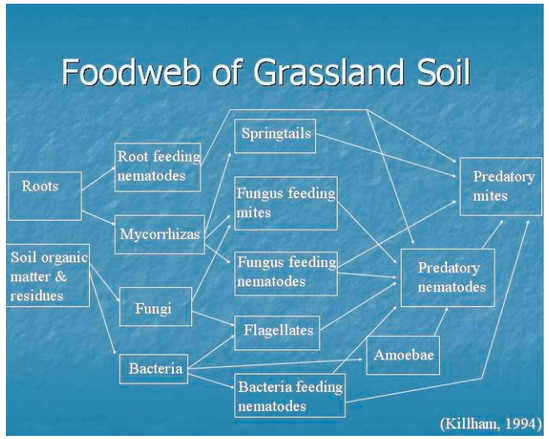
The challenge, then, for farmers, is to ensure there is an abundant and ongoing supply of easily digested organic matter, through their management practices (eg green manure crops, pasture crops, rotational grazing, no-till with stubble retention etc) to maintain the biology. Otherwise, once the food source is eaten and the micro-organism population (the soil food web) declines, additional applications of compost tea will be required to obtain the same result. Depending on the amount of organic matter in the soil, and the carbon to nitrogen ratio of that organic matter, another application could be required in as little as four weeks.

This is where productivity increases and cost (and time) effectiveness of compost teas comes into question in a commercial farming enterprise, particularly when new equipment is needed for brewing the tea and money spent on sourcing compost inoculums and monitoring tea quality.

Soil scientist, Chris Guppy, from the University of New England, likens the process of adding micro-organisms to the soil to improve its biology to putting a tablespoon of salt into the ocean to make it saltier. He says that most farmers would probably be better off adding compost to the soil rather than bothering with the compost-tea making process. It's a strategy many farmers are adopting, with ABS data showing two million tonnes of animal manures were applied in 2008.

He admits that there has been very little scientific research carried out on composts versus compost teas, probably because "for most scientists, it is self-evident that on a sheer amount of input (carbon and other nutrients), organic matter additions supply more than compost teas." Even compost tea advocates don't seem to be able to supply credible data on its benefits under Australian broadacre farming conditions.

However, Guppy points to research carried out on liquid fertilisers in New Zealand by DC Edmeades, which was published by the CSIRO in 2002. Edmeades concluded, based on field evidence, that the liquid or foliar feeds did "not contain sufficient concentrations of plant nutrients, organic matter or plant growth substances to elicit increases in plant growth when applied as recommended."




The soil foodweb is an enormously complex and generally resilient ecosystem. Brewing teas of useful micro-organisms to complement the foodweb is difficult and requires constant monitoring and can be costly.

Correct soil deficiencies first

He therefore believes that the farming dollar is better spent correcting physical and chemical deficiencies, often through the addition of organic matter, such as compost, manure, and plant matter, to feed the existing micro-organisms, rather than attempting to introduce additional micro-organisms to the soil.

"When you add carbon into the system, you're adding fuel to the micro-organisms' tank. They don't just grow, they multiply exponentially, and that's when you get noticeable improvements in the amount of soil carbon (humus) in the soil."

Nevertheless, for farmers who enjoy the process of brewing their own tea, and have the equipment and patience to apply it, compost tea can be a relatively cheap and environmentally friendly method of conditioning the soil.

Farmers should be aware, however, that it should not take the place of fertiliser (organic or conventional) as the quantities applied cannot replace the nutrients removed as part of a normal farming system.

Soil Food Web Institute accredited adviser, Gerhard Grasser advocates using aerated compost teas, as part of a broader management plan aimed at creating a diverse ecosystem both above and below the ground.

Grasser describes actively aerated compost teas as a catalyst for the release of nutrients held in the soil and organic matter.

"It's a way to get the biology in your soils working to convert energy into a form that your plants can use," he says, adding that there is a growing list of micro-organisms being discovered by soil scientists that are known to be capable of breaking down nitrogen and ammonium and converting it to a form that plants can use, as well as releasing phosphorus and other minerals that are locked up in the soil.

"Throughout time, if you have the biology working right, you should be able to reduce your fertiliser and chemical inputs but I wouldn't be advising commercial farmers to go without them entirely, and certainly not at the beginning."

Grasser is also concerned about marketing claims that 'soil health and plant production comes in a bottle', in relation to

What's in a cup of compost tea?

Compost tea is created by steeping compost in water with microbial food (eg molasses, kelp powder) and catalyst sources (eg humic acid, rock dust), and aerating the mixture for 24-36 hours. Compost teas are best brewed onsite, and applied within four hours of brewing, to maintain micro-organism levels.

Micro-organisms are sourced from the compost, and ideally multiply as a result of the brewing process.

The microbial content of compost teas will vary, according to the compost, temperature, food and catalyst sources used. Microbial activity can be measured and identified visually by microscope although this requires highly qualified technicians to carry out the test. Some laboratories will carry out DNA testing (at a cost of approximately $200) to estimate the genetic makeup of the micro-organisms in the tea.

Compost teas should not be confused with compost extracts. These are the result of steeping compost in water for prolonged periods, without aeration. Useful as a source of nutrients, they do not contain the levels of micro-organisms that a well-brewed compost tea should contain.

The Soil FoodWeb International (SFI) minimum standards for a compost tea are shown in Table 1.

Table 1: Soil Foodweb International (SFI) minimum standard for compost tea (weight of organisms per millilitre of solution or number of organisms/ml)

10-150 µg	active bacteria
150-300 µg	total bacteria
2-10 µg	active fungi
5-20 µg	total fungi
1000	flagellates
1000	amoebas
20-50	ciliates
2-10	beneficial nematodes

commercially available 'convenience' products. "There's no magic bullet," he says. "It takes time to build a stable foundation to support a diverse and resilient ecosystem. You can't just pour on a few micro-organisms and expect it all to function in balance."

He also doubts that commercially available compost teas (or inoculums available in bottles, vials or sachets) contain the levels of micro-organisms found in home-brewed actively aerated compost teas. This is because the micro-organisms require constant aeration to maintain oxygen levels – something that won't occur in a bottle.

Grasser, who advises farmers on the practical aspects of making and applying actively aerated compost teas as part of his sustainable agricultural practice, always accompanies his clients on a tour of their farm prior to making any recommendations regarding their biological management. This is to identify any factors (generally chemical or physical issues) in the soil or farm management that may be limiting soil biological function.

Key observations include the presence (if any) of earthworms, soil and plant associations and a paddock by paddock history of past fertiliser, herbicide and pesticide use. Soil and plant tissue samples are also taken.

Grasser will then suggest an appropriate recipe for the actively aerated compost tea, depending on the results of the soil tests and paddock observations. Application rates are worked out on a case by case basis, depending on the results of the compost tea samples, and will generally range between 20 litres and 200 litres per hectare.

Grasser shares Guppy's concerns that there is adequate food for the micro-organisms. Ideally, he recommends the application of good quality compost before applying any compost teas, but a range of organic matter will suffice. Examples include hay, lucerne ('green manure') and stubble.

It is also essential that there is adequate moisture available for the micro-organisms to survive and begin the decomposition process. Dry conditions will stall or halt this process.

Cost benefits

Grasser encourages farmers to consider a range of long-term benefits when deciding whether to use actively aerated compost teas in their enterprise, including:

- reduced fertiliser and chemical inputs;
- reduced use of machinery to improve soil structure;
- improvements to herd health, and
- ability to use compost teas as a foliar spray to control disease.

Some simple rules of soil science

There are some simple rules of soil science that farmers should understand when contemplating the addition of products designed or marketed to stimulate biology.

The first is that the rate at which organic matter is converted to humus (soil carbon) and nutrients such as nitrogen are made available to the plants, depends largely on the carbon to nitrogen ratio of the organic matter. Organic matter with a low C:N ratio (such as lucerne (16:1) or manure (20:1) will break down more quickly than inputs with a high C:N ratio (straw (80:1) or pine mulch (625:1)).

Second, only a tiny fraction, around 2-3%, of decomposed matter is actually converted into soil carbon each year. The cost of fertilisers and products to stimulate soil biology to build soil carbon should be evaluated with that in mind.

Third, a fairly precise ratio of carbon, nitrogen, phosphorus and sulphur (1000:83:20:14) exists in humus. This indicates that a shortfall in one of those nutrients will limit the amount of soil carbon that can be built up, no matter how many micro-organisms are added to the soil. Or, to put it another way, to build up one tonne of humus also requires the sequestration of 83 kilograms of N, 20kg of P and 14kg of S.

This highlights the importance of soil testing for major nutrients as well as soil biology when developing program to improve soil health.

So how much does it cost?

Farmers who want to make their own compost tea should budget around $0.50 per litre (if they make it themselves, including set-up costs) and $2/l if they purchase it commercially. This does not include application of the compost tea which ideally is done promptly, and with sterile equipment, to avoid loss of micro-organisms.

Application rates will vary according to the enterprise, soil type and conditions. Grasser urges farmers contemplating using compost teas to be certain of their expectations of the applications to ensure that they are not disappointed with their investment.

"It's important to work out what the farmer wants to achieve so that we get the right compost tea applied at the right time, married to the correct above-ground management," he says.

As a guide, Grasser recommends 20-40 litres per hectare to reinvigorate pasture on a good soil base, and more than 100 litres/ha for stubble digestion.

What is a healthy soil?

There is no common benchmark for a healthy or degraded soil. In fact, it may be more illustrative to conduct assessments based on whether a soil is 'fit for a specified purpose' ie for particular crops, pastures, or livestock. Otherwise, the question may be similar to asking 'how long is a piece of string?'

Also, farmers should avoid focusing on soil biology alone to determine whether their soil is 'healthy'. Soil chemistry and physical structure are equally important to soil's ability to promote plant growth and animal health. In fact, many scientists believe that if the chemical and physical components (including adequate moisture) are in order, the biology will take care of itself.

Soil scientist, Chris Guppy, says that he usually looks at labile C, pH and available P and S numbers to determine whether a soil is healthy or not. "A healthy soil will usually promote and allow plant growth, and those four items will usually indicate healthy plant growth if they are in the right order."

Farm consultant, Gerhard Grasser makes a broader assessment, most of which is done in the field. Important indicators are compaction, aggregation, porosity, humus accumulation, root development, root direction, root growth activity, root adhesion, plant root-to-shoot ratio, and earthworm activity and numbers.

"It's not unlike the assessment your doctor does when he or she checks your pulse, blood pressure, physical mobility, respiration, etc and then orders 'bloods' for various suspected conditions," says Grasser.

"The goals and realistic expectations need to be matched, and this is no different to matching the soil with the crop to grow in the most suitable weather conditions," he says.

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How to measure and monitor soil biology

Just as there is no common benchmark for a healthy soil, there is no standard test to measure soil biology.

The array of tests that are currently available should be regarded as indicative only of one or two aspects of soil biology, and therefore farmers need to understand specifically what they are testing for and why.

Further, biological tests should not replace soil tests and plant tissue tests when developing a soil management program. Tests should also be taken regularly to give a more accurate picture of what is happening in the soil under the management program.

Many laboratories offer soil biology tests but most are based on what grows on agar plates, and can identify no more than 5% of the organisms living in the soil. A more useful indicator of soil biological activity is to measure the C:N ratio (a C:N ration >25:1 suggests that biological turnover of nutrients will be low while <25:1 suggests that it will be high).

Increasing soil organic matter indicates that biological activity is increasing. Also, a diversity of organic matter above-ground will be reflected in the below-ground biological communities.

RIGHT: With so many components making up the soil foodweb, farmers should look for organism diversity in conjunction with adequate organic matter.

Table 2: Tests for specific aspects of soil biology Source: DAMIAN BOUGOURE, DPI (May 2011)

Test	Soil health information
Earthworms	C availability and soil structure
Dung beetles	C availability and soil structure
Cotton strip assay	Decomposer potential
Fungi: bacteria ratio	Ecosystem health
Microbial biomass (C & N)	C & N turnover
Microbial activity (CO_2 respiration)	Soil microbial activity (aerobic)
Microbial ID/characterisatioon	Microbial diversity and richness (up to 2,500 species of bacteria, yeast and filamentous fungi)
Functional groups (eg cellulose degraders)	Specific microbial processes
Microbial enzymes	Specific microbial processes
Bacterial genes	Specific microbial functions and structures
DNA assays	Soil borne root diseases, plant health
Molecular profiles	Microbial community structure and function
Microarrays	Multiple microbial functions and community structures