Creating Disease Suppressive Soils – Part 2

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In **Part 1** of this article, we considered the creation of optimal conditions to sponsor resilient soils. In this second instalment, we will look at how to nurture and protect our precious soil life, with a continuing focus upon humus-building strategies.

Managing the Triple C – Cultivation, Chemicals and Compaction

The three management issues with the most potential to negatively impact your microbe workforce include cultivation, farm chemicals and soil compaction.

There are three good reasons to **minimise cultivation**, including:

1. **Loss of humus** – every time you work your soil, you oxidise a little of your organic matter and it increases your CO_2 contribution to the blanket of gases that is trapping heat and dramatically changing our climate.

2. **Compromised humus-building capacity** – cellulose-digesting fungi create stable humus with a soil life of 35 years. This makes them of prime importance as a carbon sequestering tool to counter global warming. Unfortunately, these creatures are sadly missing in many soils. They are negatively impacted by fungicides and nematicides but it is often the herbicides that are doing most damage.

   The most significant of these key organisms is **mycorrhizal fungi**. This is the wonderfully productive organism that burrows into the root, just like a parasite, but it gives so much more than it takes. Once embedded in the plant root, this fungus begins creating a network of hyphal filaments that effectively serves as a massive root extension. These hyphae allow greater access to immobile nutrients like phosphorus and zinc while mining and solubilising other minerals like calcium and potassium.

   Mycorrhizal fungi produce biochemicals that kill root knot nematodes as well as substances that stimulate plant immunity. However, the most important exudate from this expansive hyphal network is a carbon-based substance called glomalin. **Sara Wright** did not necessarily understand the importance of her discovery when she was the first to identify **glomalin** just 20 years ago. However, it is now understood that this remarkable substance is the triggering mechanism for **30%** of all soil humus. In this context, mycorrhizal fungi assume a unique planet saving importance and it becomes unacceptable to slice and dice this hyphal matrix whenever we over-cultivate.

3. **Soil structure** diminishes as we over-cultivate, and our most threatened resource, the thin veil of topsoil that coats the planet, blows astray and flows away, as extreme climate events become more common.

The Chemical Conundrum

The more chemicals you use, the more chemicals you need, because the chemicals destroy both soil and plant resilience. This phenomenon is threefold. The farm chemicals kill organisms that physically protect from disease organisms through predation, antagonism and competition. They also negatively impact beneficial microbes that deliver key immune-enhancing minerals, and they kill cellulose-digesting organisms that create the stable humus that hosts the full disease suppression package.The world's largest selling farm chemical, **glyphosate**, for example, kills the organisms that deliver manganese and iron, and these two

minerals are core components of effective plant immunity. Glyphosate also kills mycorrhizal fungi, so we lose their protective effect and their humus-building benefits.

Nematicides kill a wide range of beneficials in their indiscriminate quest to neutralise destructive root knot nematodes. These include the predatory nematodes that usually feed on the root knot scourge, nematode-trapping fungi and mycorrhizal fungi. These three comprise the natural control system for root knot nematodes and, ironically, in their absence, you have just selected for the very thing you were trying to eradicate. The first creature to return after this holocaust is the root knot invader, and he thrives in the absence of his foes.

Fungicides kill beneficial humus-building fungi, along with the target pathogens, but they also compromise plant immunity. In an interview with two scientists working in the testing and registration of new fungicides for several decades, there was an interesting revelation. I was asked not to broadcast this information, and hence the lack of detail, but their admission was a real eye opener. They confessed that, in 40 years of testing these chemicals, they had not found a single exception. **Every fungicide reduced yield**, and some did so substantially. Just as immune elicitors like silica will always enhance yield as an appealing side effect, immune suppressors like fungicides have the opposite effect. Many growers have noted this phenomenon and now you know it is not just a figment of your imagination.

Copper kills fungi, bacteria and protozoa and does not leach readily from your soils, unlike some minerals. If oversupplied, it becomes a long term resident that accumulates with every application and becomes a more potent biocide with every year. Copper is actually more damaging and persistent than most fungicides and is often the most mismanaged weapon in. the limited organic arsenal

Chemicals are a short term fix with long term consequences and they carry the seeds of their own demise. It is not sustainable to continue a path where we apply more and more every year with less and less response, while destroying our soils, our bank accounts, our health and the ongoing viability of our planet. It is time to embrace real science and work with nature rather than against her. Disease suppressive soils are created with the all-important biodiversity and balance that farm chemicals compromise. The central goal in the **Nutrition**

Farming® approach is to develop viable and profitable alternatives that allow growers to move away from these chemical crutches.

Countering Compaction

When we tighten and pack down our soils with livestock or machinery mismanagement, we compromise **gas exchange**, and there is a big price to pay. In **Part 1** of this article, we discussed the most important element for soil health, **oxygen**. However, it is equally important that the byproduct of oxygen metabolism, CO_2, is able to easily exit your soil. Compaction hinders this exit, and the reduction in CO_2 for photosynthesis reduces productivity and profitability.

Compaction can also lead to puddling, with an expensive consequence called **denitrification**. The organisms, now immersed in water, still need oxygen, so they source oxygen molecules from NO_3 (nitrate nitrogen). If they strip one molecule from NO_3 they create nitrogen dioxide, which rises from the sodden soil and becomes another contributor to the greenhouse blanket. If they strip two molecules of oxygen, we have nitrous oxide, which follows the same route skyward.

The solution to compaction is twofold. We can physically reduce the immediate source of the issue with **controlled traffic** and simple strategies like monitoring tyre pressures in heavy

machinery. A Toowoomba Landcare group have recently demonstrated that this simple strategy can distribute weight more evenly, with impressive results.

The second strategy involves managing minerals, microbes and humus more efficiently. The key mineral ratio here is the **calcium to magnesium ratio**. It is all about opening up those pore spaces with calcium, which sponsors oxygenation as the soil improves. This oxygenated soil stimulates bacteria to exude their sticky slime to glue together mini aggregates (tiny crumbs) in the soil. Newly energised fungi then contribute their part in this path toward crumb structure. They use their hyphae to expand upon the bacterial beginnings, wrapping humus and clay around the smaller particles, to create **macro aggregates**. This is a critical component of soil fertility and productivity that has been seriously compromised in many soils.

Most soils are lacking beneficial fungi and the crumbly soil structure they support. Oxygen, via the improved Ca/Mg ratio, can catalyse positive change, but the cream on the cake can be the addition of **humic acid**. This natural acid is the most powerful known fungal stimulant, so it can really fire up this component of your soil life. However, humic acid also provides a direct physical and chemical benefit. This remarkable substance creates reactions that modify the permeability, porosity, water retaining capacity, absorption characteristics, surface area and cation exchange. Humic acid is the perfect tool to counter compaction, puddling, and the nitrogen losses associated with both problems.

*NTS has a wide range of humic fertilisers – **click here** for details.*

More Resilience Building Strategies

We discussed oxygen, earthworms, cover crops and humates in **Part 1** of this article. Here, we will look at three more strategies to build disease suppressive soils: compost, microbial inoculums and animal manures.

Compost, Compost, Compost

The application of compost to your soils can reintroduce a vast diversity of beneficial organisms, many of which can help suppress disease. The minerals in the compost are naturally chelated and generally feature very available forms of the trace minerals that have been shown to boost plant immunity. The humic and fulvic acids, naturally found in all composts, further enhance the suppressive potential of compost. There are no soils that will not benefit from this regenerative input and it can be a super productive strategy to either make your own compost or source a good quality, commercial product. If you have raw materials like spoiled hay, animal manure or prunings, it is well worth looking at turning these materials into valuable, soil-building inputs.

Brewing your own Battalions

Many of the key organisms involved in disease suppression can be multiplied on farm to greatly enhance their efficacy and cost effectiveness. You can beef up your army so simply, but many growers mistakenly think it is some kind of complex and difficult process. Brewing good bugs involves a microbe brewing tank, an inoculum and some microbe food. You simply add the ingredients and return 24 hours later to a brew that now contains billions of beneficial organisms in each teaspoon.

The new **Brewstar 200™** from NTS is a high performance, 200 litre system for less than $700, so it is not an expensive process to get involved with this technology. You might choose a compost tea for broad spectrum diversity or a task-specific brew like **Nutri-Life Micro-Force™** for billions of nitrogen-fixers, phosphate-solubilisers, cellulose-digesters and resilience specialists.

*The Brewstar 200™ from NTS. For information on this product, please **click here**.*

Utilising Manure to Enhance Suppression

I am often amazed at the bargain price of inputs like feedlot manure and chicken manure and wonder that they are not immediately snapped up. If you sit down with a calculator and figure exactly what you are getting, you will understand what I mean. Let's consider an aged chicken manure for $30 a tonne. The NPK analysis is 2:3:2 and there is 3% sulfur and 5% calcium also in the mix. What is this worth? Well, there is 20 kg of N in a tonne, which is roughly equivalent to 42 kg of urea. This value is $25. Next, there is 30 kg of P, which is equivalent to 150 kg of DAP, valued at $120. The K component is equivalent to 42 kg of potassium sulfate at $50. The calcium is roughly worth $10 and the sulfur about $20. We are well over $200 a tonne at this point and we have yet to factor in the carbon, the trace minerals and the microbes. Why does such a bargain exist? It must be because very few people ever sit down with a calculator.

Manure is a soil food and, if used correctly, it can be part of a package to create a disease suppressive soil. It can easily be in-field composted, if you have some crop residues present and, perhaps, a microbe inoculum that can be combined with the manure. There are cautions if you over-apply raw manure, (check with your QA certifier regarding application

regulations). There are also valid concerns that the nitrate nitrogen component can leach into waterways, if applications are excessive. One of the best tools for stabilising raw manure is to treat it with a ***Lactobacillus*** blend. The associated fermentation can really magnify the positives and reduce the negatives. In the case of dairy manure, it can truly turn a liability into a major asset. NTS will soon launch a new product containing an exciting blend of anaerobic organisms. This inoculum can be used for anaerobic composting, to enhance feed value of haylage, and as a powerful probiotic. Stay tuned.

In Conclusion

Farming becomes less stressful and much more fun if we can practise strategies that enhance the disease suppressive nature of our soils. Much of what I have highlighted in this two-part feature has been commonsense science, but unfortunately, much of what we do in the name of the modern agricultural machine is counterintuitive. We have mistreated our soils for much too long. It is now time to regroup and re-evaluate the practices that are productive and those that are destructive, in light of our new understanding of the soil as a living, breathing organism. The soil is not an inert medium in which to stand the plant; it is a vital, responsive life force that sustains all life on earth and, when we recognise this fact, we can join the regenerative revolution.

Disclaimer: Please note, all of the prices/values listed above are in AUD.

Graeme Sait

Author of hundreds of articles and a popular book, 'Nutrition Rules!'. Travels the world educating and inspiring growers and often consults at a government level. CEO of Nutri-Tech Solutions (NTS).

www.nutri-tech.com.au