Creating Disease Suppressive Soils – Part 1

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There is a growing recognition that pest management with chemicals is an inherently bankrupt approach. We pour on more and more of this "solution" each year, with less and less response. In fact, we have increased our global tonnage of rescue chemicals every year for ten decades and, every year, there is an overall increase in pest and disease pressure. We use our brilliance in technological innovation to relentlessly improve efficiency. GPS, satellite imaging, drone surveillance and robotic helpers are part of this revolution, but we have missed the most important and most basic component of stress-free food production. That missing link is **soil health**. The vitality of this magic mix of sand, clay, microbes, minerals and humus is the determinant of **sustainable profitability** for the grower, and it is the very essence of the ongoing viability of our struggling planet.

There is a very similar disconnect in the realms of **human health**. While thousands queue for the replacement of hips, hearts and assorted body parts, there is minimal focus on creating a healthy, resilient human who can avoid the scalpels, saws and suffering. Resilience is about

nutrition, and nutrition in the soil and in our bodies chiefly involves the interrelationship between **minerals** and **microbes**. The burgeoning use of symptom-treating drugs is a direct parallel to the soil/chemical story. Both approaches are proving more destructive than productive. Prescription drugs have just become our third largest killer, while our compromised topsoil is eroding at such a rate, that in just 60 years' time, there will be none remaining.

In this two-part article we will return to **root causes**, in an exploration of strategies to create a **disease suppressive soil** that reduces the need for chemical intervention and improves our farming fun. In this week's instalment, we will look at creating optimal conditions for soil life while increasing their numbers and diversity. In the second instalment, we will look at how we can feed, nurture and protect this critically important workforce.

Mastering the Milieu

The milieu is the physical environment that fosters rather than flusters, the soil life that determines problem-free farming. This vast diversity of interrelated organisms needs three things:

1. These creatures are largely **aerobic**, so they must have ongoing access to **oxygen**. The mineral ratio that determines the breathing capacity of the soil involves the balance between **calcium** and **magnesium**. Calcium opens up the soil (flocculation), allowing easy entry for all-important oxygen, while excess magnesium tightens the soil and restricts this breathing capacity. You might be thinking, "alright, let's open her up with calcium and forget the magnesium", but this would be a grave mistake. Magnesium is the central molecule in **chlorophyll**, the green pigment housed within the sugar factories that drive every process within the plant. We can't "forget the magnesium" but we can optimise the **calcium to magnesium ratio** in our soil to maximise oxygen delivery. It is essential to choose a soil test that provides reliable guidelines for the ideal Ca/Mg ratio for your soil.

2. This workforce **needs each other**. Nature demands **diversity**. Most urban dwellers soon discover that a multicultural melting pot is more fun and more supportive than a monoculture. Similarly, our soils flourish in the midst of as many different species as possible. The soil foodweb involves a diverse chain of creatures that support and sustain each other. When we kill off large segments of this chain with nematicides or soil sterilisation techniques

like solarisation, we often find we have inadvertently selected for the very creatures we were trying to avoid. The first creature that returns to ground zero after a nematicide, for example, is the root knot nematode – he thrives in the absence of the foes and competitors that were initially taken out with this soil poison. If you can bring back and sustain diversity, then you have created a soil workforce that works for you, rather than against you.

3. **Humus** is created by soil microbes and is the homebase in which they survive and thrive. It houses the moisture that sustains both soil and plant life, and buffers the salts that might otherwise damage both life forms. The crop plants, supported by humus and microbes, pump one third of their glucose into the soil to maintain that support. We have lost two thirds of our humus via chemical, extractive agriculture and **humus building** is a central strategy for creating a disease suppressive soil. Let's talk about how we can best achieve these requirements.

Oxygen Drives Everything

Oxygen is the single most important requirement for plants, microbes, animals and humans. In the soil, as mentioned earlier, the calcium to magnesium ratio governs oxygen intake. There is a different ideal for this ratio depending upon the amount of clay present in your soil. A heavy clay soil requires more calcium to push apart the clay colloids, while a light, sandy soil needs more magnesium to provide structure to a soil that has none. There is also a biological link to the creation of a soil that breathes. It is a bit of a chicken/egg scenario, in that soil life helps create the soil structure that supports itself. Bacteria exude a sticky gel that creates mini aggregates in the soil and fungi wrap those tiny particles into larger particles. Thus, we have the creation of **crumb structure**, the most desirable of all soil conditions. Oxygen moves freely into this biologically active soil, and CO_2 (the by-product of the utilisation of oxygen) moves freely out. When diffusing from the soil, this gaseous form of carbon is captured by the tiny breathing pores beneath the leaf, called stomata, and combined with water and sunlight to generate **glucose**, the building block of all living things.

It is common sense that we should be doing everything in our power to improve **oxygen delivery** in our soils, but unfortunately compaction, monoculture, over-cultivation, toxic chemistry, unbuffered salts and misuse of nitrogen can combine to do the opposite.

I have been monitoring a technology from South Africa called **Puricare**, which exemplifies better than anything I have ever seen, the incredible importance of oxygen in the soil health equation. This technology delivers a variety of oxygen radicals through the irrigation system via a combination of ozone and hydrogen peroxide called peroxone. The oxygen is delivered at a similar rate to that provided when brewing beneficial microbes, and this infusion provides a remarkable response in the soil. Crumb structure rapidly develops, earthworms return, hardpans dissolve and water infiltration and utilisation are dramatically enhanced. It doesn't stop there, however; this technology also cleans irrigation lines and neutralises substandard irrigation water. The variance in delivery of both irrigation water and nutrition, through clogged lines, is remarkably common, and it can seriously impact crop performance. There are over 1000 of these **Puricare** units now operating in South Africa with impressive reports of yield increases and reduced water use. At a time when the planet screams for the restoration of the humus building capacity of our agricultural soils to counter climate change, this exciting technology looks like a genuine breakthrough to fast track positive change.

The Puricare unit is demonstrating the immense fertility-building potential of oxygen across South Africa, and it will soon be available globally.

Diversity Drives Diversity

Diversity of plant life sponsors diversity of soil life, and Nature is all about "the more the merrier". Herein lies the fatal flaw in the monoculture model, but there are strategies that can help neutralise the negatives. The most important of these involves the inclusion of **cover crops** above ground and the introduction of a diverse **new workforce** below ground.

Why is it that cover crops always deliver more benefits when they involve multiple plant species? It is quite simple – different plants feed different microbes. If your farm features a single crop, then your soil life diversity always suffers. In my recent interview with leading cover crop expert **Jeff Rasawehr**, there was a discussion of surprise findings in multiple cover crop trials in multiple states. In these comprehensive evaluations of different cover crops, it was found that, in every instance, the final trial plot in each study that just haphazardly received all the remaining seed varieties always performed the best. It had considerably more diversity than the more controlled plots and this was the key to better performance. There is a lesson here, whether you are growing pasture or underseeding broadacre crops. If you add four clovers rather than one under a cereal crop, for example, you will do better. Similarly, if you can direct drill plantain, chicory, timothy, more clovers and perhaps some cereals into your pasture, there will be considerable gains in both soil and herd health.

A healthy, multi-species cover crop in Scotland soon to become soil-supporting mulch to sustain a new crop of honey berries. Honey berries are a new superfood with huge potential in temperate climates.

How to Build Humus

A good starting point for increasing organic matter involves bringing back your **earthworms**. How long has it been since the birds partied behind your plough in a worm-fueled feeding frenzy? Earthworms decompose organic matter to create humus at four times the rate of standard decomposition. They also oxygenate your soil and incubate new soil life, while fertilising with their nutrient-dense castings. In most soils they are sadly lacking due to salts, farm chemicals, over-cultivation and food shortages. The solution is to counter this dark side with reduced chemistry, buffering of salts and the supply of more food for the earthworms. **Humates** are the best tools for buffering the salts and chemicals, while **cover crops** are the best food source. Earthworms also love to eat beneficial fungi and protozoa, and both of these species are missing from many of our farming soils. You can brew your own fungal inoculums and you can make a simple protozoa tea from lucerne hay to regenerate these missing microbes. Then, you can watch your earthworm counts increase and your problems reduce.

In the second part of this article, we will look more closely at both **soil life stimulation** and **protection**, when striving to create a disease suppressive soil. We will also expand upon strategies to build humus in your soil.

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