



## Soil health: the key to yield success

By Kim Kleidon

*“Agriculture will only survive in the long term if soils are farmed in ways that not only repair historical damage but also improve their physical, chemical and biological properties.”*

*Pictured: Norman Marshall and Dr Greg Bender of Australian Soil Management at the Soil Health Field Day at Marian.*

There is a silent problem developing across cropping regions in Australia. No matter how much money is spent on inputs, yields are declining. Could soil be the key and could science help farmers understand nature's systems?

Soil is the cornerstone of agricultural production, yet little is known about this complex organism. Yes - soil is alive, or at least it should be.

Some farming practices though have essentially mined soils and not put back enough of what's needed resulting in lifeless, degraded and often compacted land making it increasingly challenging to grow the next crop and keeping vital nutrients and minerals out of the food chain for people.

But instead of despair there is growing interest in remediation.

“Once a soil's key functions are impaired in some way, or its most fertile components have been lost due to wind or water erosion, this limited resource begins to function in a sub-optimal manner,” says Dr Graham Stirling, a nematologist and co-author of *Soil Health, Soil Biology, Soilborne Diseases and Sustainable Agriculture*.

“Agriculture will only survive in the long term if soils are farmed in ways that not only repair historical damage but also improve their physical, chemical and biological properties.”

### Organic matter matters

The key message of the 3rd Annual Soil Health Field Day at Marian was simply - DO something to get organic matter into your soil.

Composting is one method to achieve this and according to Norman Marshall, Director of Australian Soil Management, it is the best way.

“The whole program works by balancing the chemistry,” he explains. “Compost has a job to do there.

“Once the chemistry is right, the compost then feeds the biology and the biology is the microbes which give the nutrients to the plants, which uses carbon and gets the plants to give ▶



*“I’m not feeding the sugarcane, I’m feeding the microbes and the microbes feed the crops.”*

*Pictured: Dr Neil Wilson says fungi create microhabitat niches in soil for bacteria which work to unlock nutrients and make them available for plants.*

carbon, so then this is all about building the carbon in the soils and compost is the most cost efficient and effective way of doing it.”

In a sugarcane farming system, trash left on the ground acts as a valuable and compostable soil conditioner but the speakers at the field day believe even more is needed.

Investment in methods like composting to increase soil potency and quality has produced results and **Dr Greg Bender** from Australian Soil Management cited a study in Monaro, New South Wales, where the granite and basalt soils are only fit for grazing.

“The best outcome we’ve seen is a 1% increase in carbon levels over 13 months,” he says. “Monaro’s quite cold and dry, 400mm of rainfall and below zero overnight temperatures.

“It was a big challenge for us to get carbon up in that environment. We’re quite surprised that we got such an increase.”

Dr Bender is now focussed on achieving a 1% increase in carbon levels in soil throughout Australia which he says would neutralise the country’s CO2 emissions.

There are many benefits for farmers in increasing organic matter in soils, with a key one being increased water holding capacity.

“A 1% carbon increase gives you 150,000 litres of water per hectare to the depth of 30cm in moisture storage capacity,” he says.

“You’re storing moisture rather than having runoff, it will go straight in the ground instead of into the creek or someone else’s property with your topsoil.

“What I’m talking about really is top priority for people with 400 mm rainfall where they say they’re really water managers not crop managers. Moisture, getting roots down deep so you’re less affected by climate variability.”

### Symbiosis of soil

Beyond water management, Dr Bender says other issues, like nutrition, can be dealt with gradually. He says it’s about rebuilding soil structure and letting air spaces re-form with aggregates.

The best person to explain aggregates is **Dr Neil Wilson**, a microbial ecologist from the University of Sydney, whose presentation on bacteria and fungi (considered the building blocks of life) had some field day participants feeling like they were in over their heads.

“Humans tend to approach matters with soil and microbiology as subtly as a sledgehammer,” he says. “We have operated in complete and total ignorance of the living breathing nature of soil for so long.”

So is it too late? The response from Dr Wilson was a resounding no, not even remotely close.

“There’s one thing about biology and that is resilience,” he says. “You can flog biology until it’s within an inch of its life and it will spring back.”

For broad acre farming the challenge seems immense and even Dr Wilson admits he knows ‘bugger all’ when it comes to the biology of soil.

Currently only 2% can be cultured, or grown in a laboratory. Most bacteria are only recognised by their DNA and not a lot is known about their function.

“The answer is to start to take notice of biology; it’s starting to pull back the conventional agricultural practices ... flogging the land with herbicides and pesticides, chemical nutrients that treat agriculture and, for example, sugarcane as the plant in isolation,” he says.

“You need to start looking after the soil. That can mean applying biological techniques, applying inoculants or applying things which stimulate the things that are living in the soil.

“They’re still there, they’re just not operating – they’re operating at 5% efficiency when you need them to operate at 100%.”

Getting the soil right is the first step so fungi can play a pivotal role in aggregation.

“Fungi are very important in the soil structure,” Dr Wilson says.

“Fungi are not micro-organisms in the sense of being single-celled, fungi are multi-cellular creatures and some of the largest on the face of the earth because they extend through the soil for several kilometres.

“They give the soil structure, they make the soil aggregates. ▶



"The more soil aggregates you have the more microhabitats you have for different bacteria.

"So the fungi create niches (little homes). Bacteria are the biochemical geniuses of the soil. They are the ones that can solubilise phosphorous; they can bring the nutrients that are locked up in your soil back to being available to the plant."

## Growing results

This is a fact that hasn't been lost on sugarcane farmer **John Attard** who began seeking answers to his own declining yields on the land his father also farmed.

"In the early days, we were getting a good price for our sugar so we were doing a lot of crop maintenance, putting lime on, filter press and just looking after it," he says.

"When the sugar price collapsed, we stopped doing the maintenance and we found as soon as we stopped looking after the soil, our yields just started going down and down and down.

"Now we're working with a consultant and making our own fertiliser using the paunch of a cow, which has microbes in it, and we're mixing a food source – molasses and milk - to grow the microbes and then we're putting our sulphates in it.

"We'll make potassium sulphate, zinc sulphate, iron sulphate, whatever our soil needs.

"We'll do a soil test for what we need, then the microbes break down all that sulphate so it gets rid of all that salt and what the microbes are doing is exactly what the soil is doing itself so when we put that fertiliser onto the soil it's all plant available, it can't be leached and it can't be tied up in the soil."

The biofertiliser is diluted and applied over five or six passes through irrigation injection four times per year.

John reports he's using half the fertiliser now for the same size crop, he's again adding lime and has been surprised by the results.

"Calcium's our biggest issue because we've got low pH, so now we're applying a lot of calcium to our soil. Last year was the first year I went back to putting lime on the paddocks and I got a huge response," he says.

He applied it in September and by March the crop took off.

"Now I've boosted my soils, I expect a yield increase of 10% every year from now on, but you've got to do your baseline first," John says.

It's an investment John has been happy to make. He's realised the organic potential of residues like trash, which he rotary hoes into the paddock with the addition of stubble digester, sulphates and molasses to break it down in six weeks.

"I want to build carbon," John says. "Humus is the secret there and that's what I'm doing.

*Pictured: The 3rd Annual Soil Health Field Day watched an application of lime on a Marian cane paddock.*

"I'm not feeding the sugarcane, I'm feeding the microbes and the microbes feed the crop. That's my system and I'm starting to enjoy farming again now."

What does the future hold?

Norman Marshall sees farmers playing a pivotal role in removing carbon from the atmosphere.

"It's an opportunity – countries around the world are now getting to the point where governments are paying whoever it is for storing the carbon in the soil," he says. "This is another job where farmers can get money for what they want to do."

*The 3rd Annual Marian Soil Health Field Day was run by Central Queensland Soil Health Systems and supported by CANEGROWERS, Reef Catchments Mackay Whitsunday, Landcare Australia, Mackay Regional Council, BMS LaserSat, Bayer, Eco Growth and Bio Processing Australia. ■*



**Australian Government**

This story has been brought to you by the Australian Government Reef Programme