healthy soils case study

ORGANIC SOIL AMENDMENTS

Organic Soil Amendments in Cotton Farming Systems

The background

The living soil system and its associated microbes can improve soil fertility, soil structure and potentially decrease disease problems. Healthy soils will support healthy plants. Soil tests ignore the biological component, yet there are literally tonnes of bacteria and millions of kilometres of fungi hyphae in a cotton field.

Organic matter is critical for soil health. It includes stubble, leaf litter, living plants, animals and microbes, and their degrading material as they decompose. This decomposition regulates the flow of energy and nutrients. Organic matter provides food for soil microbes, is a store for relatively available nutrients for plants, and bonds soil particles for structure.

Soil organic matter is an extremely diverse mixture of compounds: ranging in age from minutes to thousands of years; ranging in size from molecules to tree roots; and ranging in activity from bacteria to charcoal.

Low organic carbon levels in cropping soils are well documented. The quality of organic matter is also very important. Trash and stubble management are an integral part of organic carbon management and there are interesting ideas being trialled on farms in relation to feeding soil organisms. In this new era of global carbon management the cotton industry must better manage its carbon emissions and carbon losses from the soil.

Why act?

"The goal was to maximise profits and improve the quality of the farm asset"

Farmers are looking at soil organic amendments for a number of reasons. When David and Betsy Turner were farming at Macintyre Downs, Goondiwindi, their principal motivation for implementing changes was to reduce the fertiliser bill. They were

"A healthy soil is one that is productive and easy to manage under the intended land use. It has biological, physical and chemical properties that promote the health of plants, animals and humans, while also maintaining environmental quality"

David Turner

David and Betsy Turner undertook extensive soil organic amendments when they were farming at Macintyre Downs, Goondiwindi

also interested in other aspects of sustainability and had been using soil pits for years to look at the soil profiles. David noticed that gypsum had accumulated at the bottom of the wetting zone (at 1.8 m), obviously having leached through the profile. He wanted to find a way to biologically bind the gypsum to prevent it from leaching below the root zone.

What is science saying?

There is more life and diversity underground than above in cropping systems. Energy flows from the sun, through plants, and through many levels of soil organisms to cycle nutrients. The plant rhizosphere or interface between plant roots and the soil environment is the location of much soil biological activity.

Soil organisms are an integral part of soil health for several reasons:

- Decomposition of stubble and soil organic matter
- Cycling of nutrients
- Carbon sequestration

Some organisms prey on or compete with disease-causing organisms. Others can be the plant disease causing agents.

Mycorrhizal fungi help plants acquire nutrients from the soil and stabilize soil aggregates.

Small soil dwelling animals like worms, ants, spiders, and insects feed on organisms and organic matter and cycle nutrients, transport soil and create soil pores.

The solution

The Turners' organic amendments required a combination of approaches:

- Use of bulk organic matter blends including compost, humates, slow release phosphates, and soluble nitrogen
- Inoculants of bacteria and fungi to boost beneficial soil biology
- Use of compost and manure to physically import organic matter
- Application of lime and gypsum to raise base saturation of calcium and lower the exchangeable sodium
- Green manure crops such as vetch/oats to produce stable nitrogen from the legume and raise soil organic matter
- Use of stimulates with fertiliser to boost microbial activity in the root zone, such as humic acid, sugars and kelp.
- Use of humic acid with urea to increase efficiency

The benefits that resulted included:

- Softening of soil physical structure, which allowed savings in farming operations such as cultivation. Diesel use per hectare decreased.
- Improved water management, especially during dry seasons

"Relatively few products or practices individually have provided an immediate economic advantage over traditional approaches. Results usually take a season or two for flow-on effects of soil improvement to become evident in nutrient cycling, water use and soil health."

David Turner

Figure 1

This soil pit was conducted as part of the Cotton Catchment Communities CRC Cotton Production Course at The University of New England.

According to David Turner, soil pits such as this, which enable a close look at the soil profile, are an important tool in ascertaining and maintaining soil health.

- Reduced fertiliser rates
- Improved Integrated Pest Management and herbicide efficiency

The future

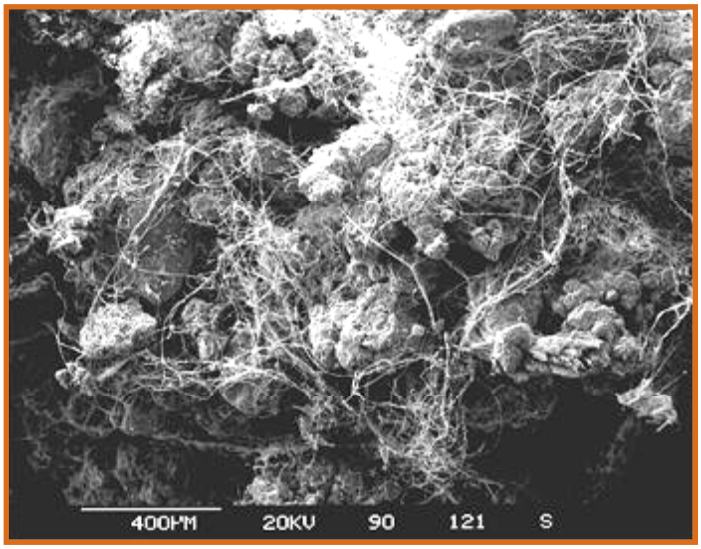
Although there is more to learn, the cotton industry has grasped the physical and chemical aspects of its soils health, and is now directing greater efforts into the more unknown field of soil biology. Major constraints of biological activity in irrigated cotton soils identified already include the lack of carbon and the presence of agrochemicals. High levels of spatial and temporal heterogeneity (that is, variation), soil type effects, sampling problems and interpretation difficulties are some of the challenges with biological components of the soil.

More research and on-farm trials in the biological area of soil management and greater cross linkages between the chemical, physical and biological disciplines are now taking place.

More nutrients are being removed from farms as a result of higher crop yields. Fertiliser rates are increasing and new diseases may become apparent in cotton farming systems. The challenging environment for soil health created by some farming activities - such as high nitrogen use, irrigation, and herbicides – may be masking the soil's ability to perform to its maximum capacity. This makes it difficult for crop managers to diagnose problems.

While water might be the high profile topic during drought, we will never grow successful crops if our soil management is not performing. Greater attention to soil biology will be critical to create wealth in the future.

Figure 2



A scanning electron micrograph of fungal hyphae contributing to improved aggregate stability by holding the soil particles together. Aggregate stability is improved by the excretions from bacteria which act like glues while fungal hyphae can bind soil aggregates together

Courtesy Dr Gupta Vadakattu, CSIRO

References

Turner, D and Davidson, B (2004) *Biological Farming Systems*. 12th Australian Cotton Conference, Gold Coast Qld, pp229-232.

Knox, O (2007) *Soil Biology – what is it and what impact does management have on it?* Healthy Soils Regional Symposium Proceedings, Cotton Catchment Communities CRC.

Soil Biology – What is hiding in the ground? Cotton CRC Information Sheet. http://www.cottoncrc.org.au/content/Industry/Publications/Soils.aspx.

For further information, contact:

Cotton Catchment Communities CRC
Phone: 02 6799 1500
Locked Bag 1001
Narrabri NSW 2390
www.cottoncrc.org.au

PROJECT PARTNERS

Australian Government
Cotton Research and Development Corporation
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