

What lies beneath – the significance of soil biology

KATHERINE MAITLAND

Soil biology, the study of the living components of soils, is an important term in agriculture.

Understanding the critical levels of key bacteria, fungi and soil animals such as nematodes that make up the soil's ecosystem can help growers improve crop yields and productivity.

How these organisms interact can also have an important role in the cycling of carbon and nitrogen in the soil and in suppressing the impact of disease.

According to Kathy Ophelkeller, Research Chief with SARDI's Sustainable Systems Division, a healthy soil has biological, chemical and physical properties that promote the health of plants and maintain environmental quality.

"It's important for growers to know that soil quality can be monitored using a range of physical, chemical and biological indicators," Kathy said. "Biological indicators respond more quickly to changes in management or environment than physical and chemical indicators but we know less about them than we do about soil physics and chemistry. We certainly don't know their critical levels."

Observations from her work on DNA-based testing for soil-borne organisms suggest that soil nematodes and micro-organisms play an important role in soil health by supporting the cycling of carbon and nitrogen in soil. They also suppress the impact of disease.

"Soil microorganisms play a key role in chemical pathways in soil, such as the cycling of carbon and nitrogen, which are required for plant growth. Micro-organisms including mycorrhizal fungi can increase the availability of mineral nutrients such as phosphorus to plants and nitrogen-fixing bacteria can transform atmospheric nitrogen into forms of nitrogen that can be used by plants.

"Soil microorganisms can also have an important role in suppressing the impact of pathogenic soil-borne fungi and nematodes on plants, and in disease-suppressive soils," she said.

Nematodes are vital to the overall health of the soil, and the types and numbers of



SARDI NEMATOLOGIST KATHERINE LINSELL.

nematodes present can be used to provide information about the soil ecosystem.

"Many growers are aware only of pest nematodes like cereal cyst nematode (CCN) but most nematodes are not plant parasites. There are also bacterivores, fungivores, omnivores and carnivores.

"Nematodes, which are categorised according to their feeding habits, are useful biological indicators," Kathy said. "They occur in all soils, are readily extracted and identified, have a wide range of food sources and their population density fluctuates in response to changes in food sources and soil structure and chemistry.

"Nematodes are therefore widely used to assess the impact of land management practices on overall soil conditions and are invariably one of the parameters measured in studies of soil biology and soil health."

SARDI is part of a GRDC-funded national Soil Biology Initiative (SBI) to

develop information on soil biology.

"The Initiative aims to link biological indicators and soil processes so we can develop guidelines for biological indicators similar to those for the dynamic physical and chemical indicators."

The nematode section of the SBI, which is using DNA technology to quantify key nematode groups in soil, involves SARDI scientists Katherine Linsell and Alan McKay and Dr Graham Stirling, an expert on plant-parasitic and free-living nematodes from Biological Crop Protection in Queensland.

"This DNA technology is used routinely in the PreDicta B soil testing service developed by SARDI to provide cereal growers Australia-wide with an indication of pathogen levels in cropping paddocks and by scientists to assess soil biology in field trials," Kathy said.

Predicta-B technology is currently used as a diagnostic tool for plant-parasitic



KATHY OPHELKELLER, RESEARCH CHIEF FOR SARDI'S SUSTAINABLE SYSTEMS DIVISION.

nematodes and other soil-borne pathogens. Tests for free-living nematodes may be added to the PreDicta B service once the critical free-living nematode groups have been identified.

“In 2011 and 2012, the first two years of the project, the team processed soil samples from farm paddocks and tillage and rotation trials manually to obtain a picture of key nematode groups and their levels across different soil types and management systems.

“The results are giving us information on how soil type and regional climatic differences impact on nematode communities and will show us how different crop management practices affect soil health. We are particularly interested in determining which management practices increase the proportion of predatory and omnivorous nematodes that feed on other soil organisms, because these may be a better indicator of soil quality.

“By 2014 we will have DNA tests to quantify the omnivorous and predatory component of the nematode community. Once these new tests are available, growers and researchers will be able to access information about the beneficial organisms in their soil as well as the pathogens,” she said.

To find out more about soil biology and how to improve soil management practices, visit www.soilquality.org.au 

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