



## Testing for soil microbiology and soil health

### What do soil microorganisms do for the soil?

Soil microbiology is an essential part of a healthy soil and necessary even in a degraded soil for:

- the conversion of plant unavailable nutrient forms to plant available forms
- breakdown of organic matter
- metabolic processes in the soil
- important plant relationships around the plants root system.

Healthy soils contain a diverse microbial population including a range of fungi, bacteria, nematodes, protozoa, etc. Microbes vary in population and species according to seasonal conditions, soil properties such as pH, as well as under different management systems.

### Why soil test?

From an agricultural perspective, soils are generally sampled for the plant essential nutrients they contain. It's the concentration and form of these plant essential nutrients that affect plant nutrient availability. Soil test results are used to determine a fertiliser or amendment recommendation that will assist the grower in producing a certain target yield –

whether it be crop production or pasture growth. However, soil microorganisms have an important role in the availability of some nutrients.

### Challenges in testing for soil microbiology

Agricultural chemists have worked out that certain chemicals (with varying degrees of accuracy) when added to soil samples in the lab will mimic specific soil processes. However, to date we have not successfully developed a meaningful suite of biological soil tests that provide us with a clear practical indication of the soils complex natural systems, microbial populations, sustainability and health.

Obvious problems arise when considering just what aspects of the soil to test and measure to provide meaningful and credible results. This is largely due to the vast number of species of bacteria or fungi that are present in soils. It is difficult to determine which ones would form the best indicators of a balanced microbiological population and how we apply these results to management practices.

### Soil health assessment

A full soil health assessment would encompass many aspects that go together to produce a healthy soil. The conventional soil test deals mainly with nutrients that give an indication of the soil's fertility. A soil health test and assessment would include many other aspects



of the soil, some qualitative and some quantitative. Some are listed below;

1. The health of plant root systems, nodulation of legumes
2. Soil colour and smell
3. Soil compaction/aeration
4. Degradation of organic matter in top soil
5. Waterlogging and soil water content
6. Absence of soil borne diseases
7. Nutrient status as well as nutrient cycling
8. Soil structure and aggregate stability
9. Resistance to erosion - adequate ground cover, minimum of 30%, aim for > 50%
10. Salinity and/or sodicity status

Most of the factors listed above can be readily assessed on farm on a regular basis without much expense.

### Components of the Soil Health Test

This proposed soil health laboratory test can be undertaken at the same time as chemical analysis and from the same soil sample following the standard sampling protocol. There are four components to the proposed soil health test. Each of these will individually provide credible information about soil processes. When combined, these tests will not only provide a picture of seasonal soil conditions, but also over time will demonstrate invaluable trends.

1. **The carbon: nitrogen ratio** – The carbon: nitrogen ratio measures the rate of mineralisation of soil organic material. A close ratio will indicate whether the ratio is close enough for mineralisation to occur. A wide ratio will indicate that there is a likely case for immobilisation to occur.
2. **The active or labile organic carbon test** - This test gives an indication as to how much of the soil organic carbon is biologically available. Sufficient levels of biologically available soil organic carbon are generally indicative of the amount of organic matter

in the soil and the soil texture. The level should be within a range and above a minimum. More is not necessarily better in this instance as the goal is not to accumulate this carbon in the soil, but rather have it turned over and used by the soils microorganisms for their respective functions.

3. **The Total Microbial activity test** – will give an indication as to the amount of a certain group of enzymes being produced by certain soil microorganisms. These enzymes are present in all soils and sensitive to changes in seasonal and management conditions. The number of enzymes will provide an indication of microbial activity in the soil and can be used in conjunction with the active carbon test. By using both tests, it may be possible to develop a method of interpretation to quantify “true” biological activity and potential for biological activity independent of recent soil climatic interactions. The numbers obtained will need to be interpreted with respect to conditions such as soil moisture, soil depth, soil constraints and root activity.
4. **Emerson aggregate class test** – gives an indication as to the behavior of soil aggregates when in contact with water. It shows whether the soil is likely to disperse and be the cause of a soil constraint to plant growth, possibly requiring the application of amendments.

A soil health test will provide a guide to landholders about the microbial activity in the soil and overall biological health it would also complement nutrient based soil testing and provide results which can be considered together when making management decisions.

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