Identifying key soil indicators for sustained agricultural production

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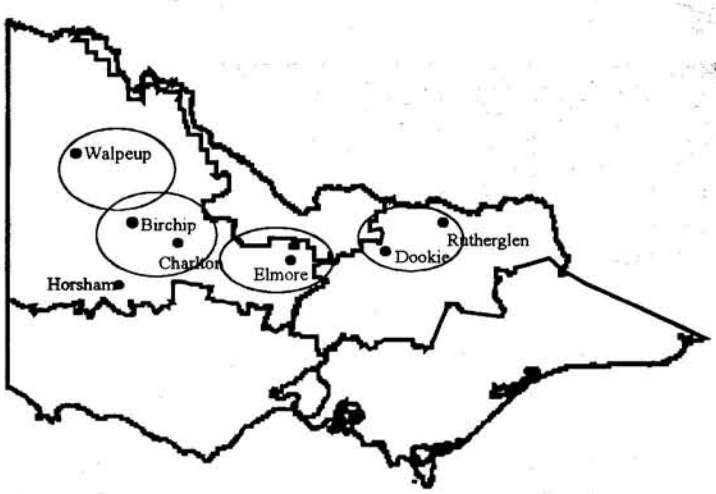
Background:
As growers increase the complexity and intensity of their crop rotations, more is demanded from their most important resource, the soil. Greater emphasis is placed on such issues as productivity and sustainability. Yet attempts to evaluate the impact of various farming systems can be difficult. How do we compare different systems? What sorts of things should we be measuring? What are the benchmarks?

One project, partly being conducted in the Birchip area, will help us to answer these questions. Titled "Identifying key soil indicators for sustained agricultural production", it is funded by the Victorian State Government's 'Agriculture and Food Initiative', and involves Department of Natural Resources and Environment staff from Rutherglen, Birchip and Walpeup. We will measure the biological, chemical and physical aspects of different management strategies on particular soils. The areas involved are those commonly used for cropping in the Mallee, Birchip, Bendigo and North-East regions of the state. A total of 117 individual paddock sites have been selected for the study.



The main aim of this project is to determine the current status of the soils with respect to degradation or conservation. A relocatable site within each paddock has been sampled to allow baseline data to be calculated. This work cannot stand alone, and will only provide a reference point for future studies. In the longer term, the benefit to industry will be the identification of those farming systems that are truly sustainable, and those that are leading to further soil degradation.

Method:
Soil samples from four depths (0-2.5, 2.5-5, 5-10 and 10-20 cm) have been taken from a chosen point in each paddock. At each site, GPS readings and CFA map references have been recorded, and transponders buried one meter underground, to enable easy relocation of the sites in the future.

All sites were sampled within a 5 m radius of the transponder and analyses performed will be chemical (pH, EC, organic C, N, P, Ca, Mg, Na, K, Al, Mn, Mo, B, Fe, Soil solution), biological (total counts, Rhizobium, fungi, earthworms) and physical (porosity, bulk density, compaction, mechanical analysis, water infiltration). All samples will also be formally classified using the 'Isbell' Australian soil classification system. The results will be communicated to landholders through meetings and individual reports. Whilst this is a complex and time-consuming project, it is worthwhile because real farm systems are being assessed, and the co-operators are able to communicate directly with the scientists involved.

Results and Discussion:
Full laboratory analysis of all samples has not been completed, but some interesting data has already emerged. The graph presented below (figure 1) shows the organic carbon (C) levels for the soils from the Birchip, Charlton and Elmore areas. The results indicate the wide variation between these soils. Included in this group are 58 samples taken from paddocks which have not been cultivated (undergone only minimal cultivations in recent years). We can compare these figures with those from soil that has been conventionally cultivated.

Carbon (C) in soils has several functions; It is an energy source for microorganisms (worms, fungi, bacteria etc;), it acts as a matrix contributing to soil structure and it provides a reactive surface that helps to reduce the rate of soil acidification (especially in low pH soils).

In some areas, agricultural practices have reduced the soil organic carbon levels, from as much as 5% under native bushland to under 1%. Farming practices that include conservation measures such as stubble retention can increase organic carbon, but only very slowly - about 0.1% in 10 years. In contrast, long pasture phases have the potential to increase organic C more quickly, to a theoretical optimum level of around 2%.

Figure 1. Soil organic carbon (%) from 49 of the 117 sites.