Results of the soil treatments at the Pridhams' farm

May 2012 update

The South East Natural Resources Management Board (SE NRM Board) has been implementing an Enhancing Soil Health project during 2010 - 2013, with funding provided by the Australian Government Caring for our Country program and the SE NRM Board.

As part of this project, the SE NRM Board is supporting demonstration sites on Mark Pridham's property at Western Flat. A demonstration farm is not a scientific trial; rather it tries to measure things that are happening in working farm situations.

Mark has been applying lot of different treatments to the soil on his farm over the last decade. These treatment sites are being used by the Enhancing Soil Health project to test soil conditions such as carbon content and acidity levels following the treatments.

THE LANDSCAPE

The land at the Western Flat demonstration farm is of a Dune-swale landscape, comprising deep sandy dunes and sand over clay flats.

Geologically it is made up of recent Molineaux sand (windblown sand) deposits overlying far older Parrilla sand (weathered sandy clay) deposits. The soils are generally strongly weathered; comprising low fertility bleached sand over infertile, kaolin dominated sandy clay.

WHAT ARE WE MEASURING?

A variety of treatments on the farm that can potentially influence soil pH and / or soil drainage are being measured. These treatments include:

- Surface liming,
- Mixing the soil profile using a clay delving machine,
- Establishing plant species with a range of acid tolerances.

Paddocks and treatment evaluated 2010- 2011
Site/Treatment

1. Control
2. Spaded clay @250t/ha.
3. Spaded green manure + clay in 2009 @ 300t/ha (600t/ha on rises) – vetch #
4. Spaded green manure + clay in 2009 @ 300t/ha (600t/ha on rises) – clover
5. Spaded green manure + clay in 2009 @ 300t/ha (600t/ha on rises) – trit #
6. Clayed 250t/ha + compost, super, calsup, trace – Lupin '05, pasture '06-'07
7. Clayed at 600t/ha
8. Potatoes + calsap (5+8L/ha)+ trace + 800t/ha clay (3 applications) #
    a. clayed 1999 150t/ha. Lucerne #
    b. clayed 2003 250t/ha. Lucerne.
9. New clayed lucerne #

Natural condition

Clayed and irrigated

1. Due to high levels of clay and green manure added to the top 20cm of the soil, there are significant physical changes to be observed in the soil of several of the treatments sites, including colour changes from infertile looking grey and white to brown with a more visible organic content. In addition, the soil's surface texture changed from a sand to a loamy sand, increasing the estimated clay content of the top 25cm by perhaps 3 or 4 times.
2. The hardness of the soil measured by a penetrometer found the soil types, which are shallow to clay, have a tendency to be less hard than the deep sand. Further investigation is required to determine the extent to which soil management also plays a role in the friability of the soil.
3. There was a relationship between pH and extractable **aluminium (Al)**. A pH_{ca} of 5 represents a useful threshold below which aluminium becomes increasingly problematic, with an aluminium content above 2 ppm likely to affect sensitive plants.
4. There is a relationship between clay content and fertility. Measurements of cation exchange capacity (CEC) have been measured to increase with rising clay content in the soil at the demonstration site. The CEC was greatest for the two sites which had received 600 and 800 tonnes/ha of clay respectively. There is also a straight line relationship between the CEC of these soils and the level of Colwell extractable **potassium (K)**.
5. There is also a good relationship between the Colwell K and Colwell **phosphorus (P)**. If you use the K measure as a surrogate for clay content, this supports the importance of clay in enabling the soil to store P. Clays in the Western Flat area contain iron and aluminium oxides, and the addition of clay to the surface soil should increase its P storage capacity many times over.
6. A good relationship between total P and Colwell P has been developed, which could be used to determine how much extra P is required to get to a certain target level (around 20ppm for sandy soils). With good management it may be possible to achieve nearly 100% efficiency from applied phosphorus fertilisers on clayed soils. By using tests of total P and Colwell P you can also monitor whether you are losing phosphorus to leaching.
7. On this demonstration farm there is a relationship between increasing K content and increased soil organic carbon (SOC). This supports the role of clay has in protecting carbon in the soil from being broken down and lost. Over time soils with clay added to them should increase their carbon level. In addition, the incorporation of clay, organic matter, and legumes appear to have had the effect of increasing soil carbon and nitrogen, and the deep mixing from the spading and discing has meant that significant amounts of carbon and nitrogen have been placed in the 10-30cm zone of the soil. Where the spader has been used, the organic carbon has been diluted into a greater depth of soil.

NEW INFORMATION

Further investigation was undertaken into 5 paddocks/ treatments during 2011/12. This included paddocks that had the following treatments:

Site 3 – Spaded green manure + clay in 2009 @ 300t/ha (600t/ha on rises) – vetch

Site 5 – Spaded green manure + clay in 2009 @ 300t/ha (600t/ha on rises) – clover 2011

Site 8 – Potatoes + calsap (5+8L/ha) + trace + 800t/ha clay (3 applications) – cereal 2011

Site 9A – Clayed 1999 150t/ha – Lucerne

Site 10 – New clay area near house – lucerne 2011

Investigations included soil and plant analysis and bulk densities of soil layers. Plants were sampled on September 2011 all on whole tops during flowering. Soil analysis was undertaken in late 2011 and early 2012 for deep **nitrogen (N)**.

Acidity – 5 paddocks by 3 depths

Soil pH levels again indicated acidity is an issue on some paddocks, although toxic levels of Al (where > 2 mg/kg) did not occur.