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RAMBLING AROUND THE FARM - SOIL

By Andy Cowan

When I first started "Rambling around the Farm" I made the comment that "Soil sampling is a great method of recognizing trends. Considering that soils are generally heterogeneous, varying in organic matter and mineral, clay, silt and sand content, it is more than likely that an accurate indication of the status of your soil will never be known. If you take a 1 kilogram sample from one hectare of soil 10cm deep, you are sampling (depending on the bulk density of the soil) maybe one in 1,500,000 kilograms – arguably not statistically significant!!" As the whole process seems pretty random I thought I might throw a few more causes for variation into the mix.

Letting the laboratory know to what depth you sampled your soil is critical. Historically the depth to which soil was tested was based on the depth of a mouldboard plough – about 6 inches. In the old currency, it works out mathematically that an acre-sized block of a silt-loam soil, 6 ¾ inches deep, would weigh approximately 2,000,000 pounds. This makes an easy conversion of soil test numbers in parts per million (ppm) to pounds per acre of nutrients, estimated to be available to the crop. Simply multiply the ppm value in the soil test by 2 to convert to parts per 2 million, or pounds per acre. That is to say, if your test tells you that you have 12ppm P available in our soil and you want to raise the level to 20ppm you will have to add 16 pounds of P per acre. This is approximately 182 pounds of single super per acre that is needed to reach this target.

The question remains . . . why do many Australian laboratories only request a 10cm sample? My first thought was that, in the 200 years that there has been white settlement in Australia, we have managed to reduce the level of top soil so dramatically that the European system did not apply to us, but I was just being cynical. I guess it must have been because of the ease of calculating in the metric system. In the example above, the bulk density of the soil is approximately 2230 lbs/cubic yard, which is the equivalent of about 1325 kg/m^3 or a middle of the range silty loam soil. Sandy soils and organic matter have bulk densities of about 1800 kg/m^3 and about 700 kg/m^3 respectively. Soil in 1 hectare by 10cm deep is 1000 m^3 of soil. If the soil has a bulk density of 1000 kg/m3 – this brings us back to the 1,000,000 figure and the ppm conversion.

One reason that I am convinced that the soil and its management are so critical is that when I have to spend money buying in feed, I go broke. If I can learn to manage my soil, my pastures and my stock better I will be a lot better off financially. It is possible to be more profitable by being smaller and more efficient!!

There are a number of critical issues involved in soil sampling. Briefly they are same soil depth for each sample; the same environmental conditions each year; the greater the number of cores per test sample the better and try to detail where the samples have been taken from. If you are really serious, you could try using a GPS to record the position of each sample taken. Air-drying the sample as soon as you have taken it reduces the microbial activity in the sample and may give more reliable nitrogen values. The reasons for taking soil samples is to examine changes in fertility over time, predict the long-term probability of response to fertilizer and to help determine nutrient rates needed to boost productivity.

I have recently been involved with a Whole Farm Planning Group and one of the guest speakers mentioned that soil tests need only be taken every 4 or 5 years. I have tried to take samples, on average, about every 3 years – but I can see her point. Once you believe you know the direction you have to go, and the quantities involved, there may be little point in continually checking up on your progress. Especially when there appears to be such variation in the results. This idea can be aided by the fact that you should have a nutrient budget for your farm and therefore understand what elements are leaving the farm each year. One thing you may wish to ponder is "How did your land get its fertility in the first place??"

I just wanted to go into more detail about the environmental conditions in which the samples are collected. They are quite critical.

Seasonal variations in soil test results have been recognized by soil scientists for more than 40 years. Sizeable fluctuations in soil test levels can occur seasonally (monthly even) and are associated with changes in soil temperature and moisture, soil microbial activity, crop residue decomposition, clay mineralogy and nutrient recycling. Shallow soil samples (up to 10cm) will be more susceptible to seasonal fluctuations in test results than samples collected from greater depths. Plant roots can modify the pH in their rhizospere which affects their ability to take up nutrients. I sample to 15cm because I am trying to develop deeper soils based on perennial pasture species.

How much variation can be expected across seasons and within a year? Soil pH can vary as much as 0.5 to 1 pH unit on poorly buffered soils, especially on the coarser textured soils – ie: those lower in organic matter. Soil pH is usually higher in dry periods and lower in wet conditions. When you consider that the pH of rainwater is about 5.7 it is easy to explain why most of the high rainfall areas in Australia are acidic. Measurements and results for extractable soil phosphorus may be more stable than soil pH and extractable potassium in the majority of soils. Under prolonged flooding, phosphorus associated with iron complexes can be released. When soils dry, phosphorus can be bound tightly in iron and aluminium complexes, which lowers its availability to plants. Seasonal variation of phosphorus can be as much as 5 to 10 ppm.

Extractable soil potassium can be affected by soil freezing and thawing and variations in soil moisture. Under very dry conditions, and upon freezing, certain clay minerals can release potassium from their mineral structure. Upon re-wetting, the potassium may be bound in the clay structure. In some high clay soils, the seasonal variation can be as much as 10 to 25 ppm. Older, more highly weathered soils may be less likely to show strong seasonal variations in extractable potassium levels. Seasonal variation in extractable potassium in sandy soils can be large.

Extractable soil sulphates and nitrates – are affected by microbial activity. Release of ammonium and nitrate-nitrogen and sulphate-sulphur from organic matter slows in dry soils. Existing nitrate levels can decline when soils are saturated for extended periods, especially during warm weather. Unlike nitrate, sulphate-sulphur is not prone to atmospheric losses during saturated conditions. Soil nitrate and sulphate levels can more than double/halve seasonally.

There is no practical or reliable way to adjust results or recommendations based on the environmental conditions. The adage is “sampler beware”. This is why, in order to obtain the most consistent and accurate soil test results and recommendation possible, it is best to minimize all possible variables.