Determining fertiliser nutrient requirements (7-2)

Summary

- The quantity theory should be used to determine nutrient requirements
- Monitoring of soil test trends over time and/or the maintenance nutrient requirement module in OVERSEER then needs to be used to determine the sources of nutrient and how much nutrient is required to be added to the soil as fertiliser.

Base cation saturation ratio theory

This theory emerged in the 1930’s and is being promoted as an alternative method of soil testing and fertiliser advice to the quantity theory (see below).

The theory is that the ratio of the nutrients calcium (Ca), magnesium (Mg) and potassium (K) are important for soil quality, plant health and plant growth. Usually the ratio is expressed as the amount of Ca, Mg or K as a proportion of CEC (cation exchange capacity or base saturation percentage (BS%)).

It is claimed that there are ideal ratios. However, national and international scientific evidence does not support this theory and there is no such thing as an “ideal ratio”.

There is added reason not to base fertiliser advice on the base cation ratio theory. It is to do with the fact that the cation exchange capacity of NZ soils depends on the pH at which it is measured. What this means is that the traditional method used to measure CEC greatly overestimates the real CEC of the soil. In turn this means that the calculated base cation ratios are greatly underestimated. For example, a strict application of this approach indicates that most soils in NZ are calcium deficient even though Ca deficiency does not exist in our soils.

For these reasons the ratio theory can result in making fertiliser recommendations of nutrients that are in fact not required i.e. no economic gain as no more pasture is grown.

Quantity theory

For plant growth to be optimised the minimum quantity of each of the essential 16 elements is required (refer Farmfact 7-1) and the rate of plant growth depends (other things being equal) on the nutrient that is most limiting. This is Leibig’s famous “Law of the Minimum”.

A balanced soil for plants can therefore be described as one that contains the minimum quantity of all the essential nutrients for plant growth
Liebig likens the potential of a pasture or crop to a barrel with staves of unequal length. The capacity of this barrel is limited by the length of the shortest stave and can only be increased by lengthening that stave. When that stave is lengthened, another one becomes the limiting factor.

How is the minimum quantity determined?

For those nutrients which have calibrated soil tests for NZ soils (P, K, S and Mg) sufficient fertiliser needs to be added to:

1. bring the soil test levels up to the optimal range and
2. to maintain these nutrients at the optimal range based on the loss of nutrient from the soils through product leaving the farm gate, leaching and run-off.

There is a range of nutrient sources including effluent and solid fertilisers.

For nutrients where there are no calibrated soil tests, such as Mo, Mn, Zn and Fe, clover only tests are required. To make sure that the animal is getting sufficient Mg, Na, Cu, Co and Se and not excessive amounts of other nutrients like K, Mo and Mn, mixed-pasture samples are required.

For more information refer to:
- Farmfact 7-1 Plant nutrition
- Farmfact 7-3 Soil testing
- Farmfact 7-20 Nutrient budgeting

References
Edmeades, D C. The Fertiliser Review Number 26 available at www.agknowledge.co.nz.