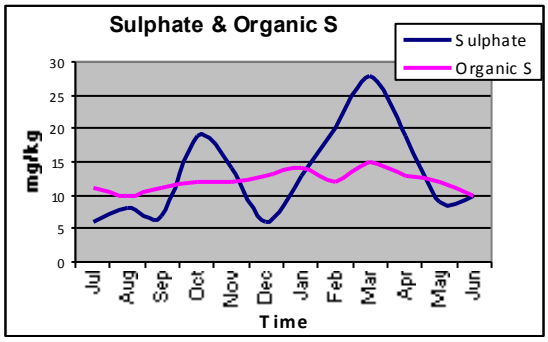
Soil Sulphur

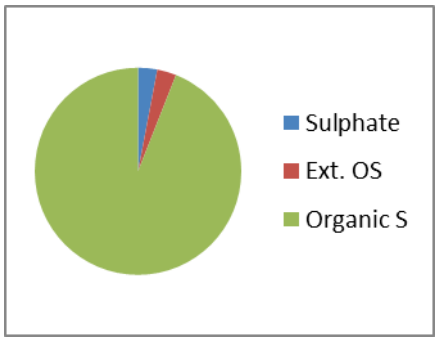
Sulphur (S) is an essential element for all plants and animals and is a key part of proteins. In legumes, S is a vital component of nitrogen fixation by the bacteria found in legume root nodules.

The form in which S is taken up by plants from the soil is as the sulphate (SO_4^{2-}) anion. Soil sulphate levels are routinely assessed in many NZ soil tests. However, the SO_4^{2-} ion is very soluble and thus very mobile in the soil. As a result, S test results can often be misleading i.e. a good level can change reasonably quickly to a deficient level, especially if the soil is wet (Cf graph below for typical seasonal fluctuations).



Desired levels of soil sulphate vary depending on land use and stocking rate but are usually within the range of 7-15mg/kg (75mm soil depth).

Sulphate is easily leached down the soil profile and out of reach of shallow rooting plants. As a result, S availability can be a problem in high rainfall areas or on soils which are free draining. This situation is compounded if the anion storage capacity (ASC or P Retention) of the soil is low. In the latter case, there are fewer soil sites available to hold the sulphate anion in the soil.

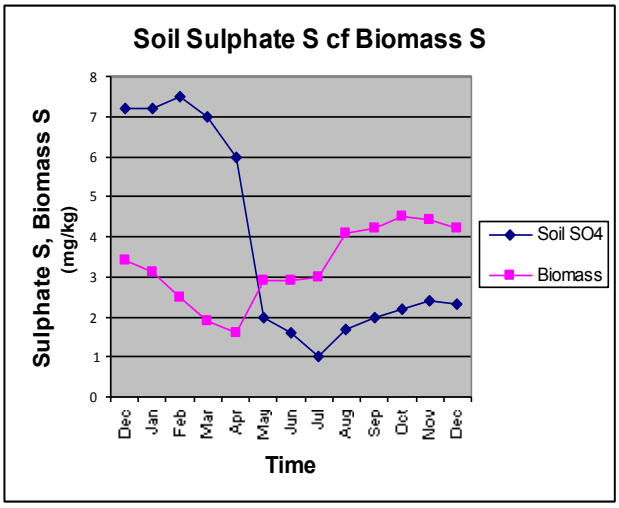


Fortunately, most of the S present in the soil is in organic form (approx 95%) which is not easily leached from the soil. However, before organic S can become available to plants it has to be decomposed and converted into inorganic forms of S. This process is controlled by soil microbes and requires warmth, moisture, a food supply for the soil biology, and time. In essence, the S present in the soil organic matter acts as a reservoir which provides an ongoing source of supply of the sulphate that plants require.

To overcome the variability of the sulphate S test, it is worthwhile considering two other soil S tests which complement the soil sulphate test – Ext. OS (easily extractable organic S in diagram above) and total S (Organic S in diagram above). The Ext. OS test gives a good estimate of the ability of the soil to supply plant S requirements from the mineralisation of organic matter over the medium term, say 6-12 month period. This is a significant farm management advantage over the sulphate test alone. Similarly, the total S test gives an estimate of the total pool of S stored in organic form, and hence an indication of reserves of plant available S that can be made available over a longer period of time.

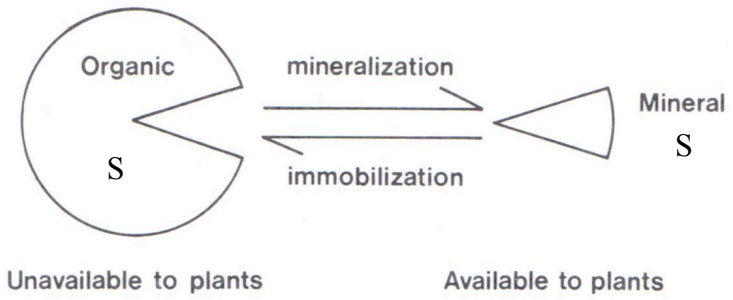
What does this all mean for the farmer? In the winter-early spring period, soil sulphate levels can be a problem. Much of sulphate in the soil in the autumn is removed by leaching as a result of high soil moisture levels over the winter. Because soil temperatures are also lower at this time of year, mineralisation of sulphate from organic matter will also be low until temperatures rise again. Thus, as

already indicated above, right at the time when the plants have an increasing sulphate requirement, soil sulphate levels are low. This is a good time to add S fertiliser.



Applying superphosphate in spring can often result in a good pasture growth response to the fertiliser. But, in many cases, this response is not due to the phosphorus (P) in the fertiliser but to the low S at this time of year. If P is not deficient, why waste money applying both P and S, if only sulphur is required? Conversely, if soil S levels are adequate, why not select a fertiliser that will supply just the P required, rather than P and S. Clearly, it makes sound economic and environmental sense to only add the nutrients that are required.

S is a significant component of dung and urine. This is another important variable to soil sulphate levels across a paddock, particularly in a pastoral farming situation. It is therefore very important when collecting samples for a soil test, to collect a good number of sampling cores to bulk up into the final sample, rather than just a few. This greatly improves the chances of a representative test and a meaningful soil test result. Good sampling technique helps reduce the likelihood of an aberrant soil sulphate test result.



Soil S is in a dynamic state. Most of the soil S is found in organic form, but in favourable soil conditions, some of this S is mineralised into inorganic or mineral forms i.e. the SO_4^{2-} anion. The latter is then taken up by plant roots, and the cycle begins again etc. A good understanding of this S cycle will help to ensure on-farm S management is optimised.

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