Sulphur fertiliser (7-13)

Sulphur (S) is the cheapest of the major nutrients and costs about $0.35/kg S. Unlike P it is not a pollutant and hence the appropriate attitude towards S deficiency is to eliminate it – it is nonsensical to limit the expression of other more expensive nutrients by operating at non-optimal soil S levels.

Clover has a higher requirement for all nutrients including S, relative to the grasses. Thus, if a soil is S deficient the clover vigor and abundance will be poor. Correcting S deficiency results in an increase in clover growth and production.

Optimal soil S ranges

There are two pools of available soil S:

1. The sulphate S test measures the pool of immediately (day-weeks) available sulphur. This is the smallest pool and makes up < 5% of the plant available S. Sulphate S levels fluctuate over time due to the addition of sulphate fertilisers, dung and urine, and loss of sulphate S during leaching events.

2. The organic S test measures the long-term (months to years) supply of organic S that can be mineralized and made plant available over time. This is the largest and most important pool of S makes a soil S. It is no affected by leaching or by the addition of fertiliser S. For this reason it is less variable than sulphate S and hence a more reliable test (see Farmfact 7-3 Soil testing).
Providing there have been no recent additions of fertiliser S or leaching events, the two S pools will be in equilibrium and the concentration of sulphate S will be directly related to the amount of organic S. For this reason the optimal ranges for pasture production are the same:

<table>
<thead>
<tr>
<th>Soil group</th>
<th>Optimal range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sulphate S</td>
</tr>
<tr>
<td></td>
<td>Organic S</td>
</tr>
<tr>
<td>All soils</td>
<td>10-12</td>
</tr>
<tr>
<td></td>
<td>10-12</td>
</tr>
</tbody>
</table>

If the organic S level is > 10-12 it means that the soil has sufficient organic S such that the amount of sulphate S mineralized during the year will be sufficient to meet the annual pasture S requirements without the need for additional fertiliser S.

Under a clover-based pasture organic S accumulates slowly up to a maximum. For some soils (drier sedimentary soils) the maximum possible is less than 10-12. It is simply not possible to increase the organic S levels up to and above the optimal. For these soils, applications of fertiliser S are essential to meet the annual S requirement. This is one reason why the drier sedimentary soils are S deficient in their natural state.

Sulphate S, but no organic S, is mobile like K and is therefore susceptible to leaching. After a leaching event the soil bugs via mineralization restore the equilibrium sulphate S concentration. Note that organic S does not leach and hence the soil is never completely depleted in S even after a long leaching event.

Under prolonged cold, wet conditions, such as the end of winter and beginning of spring, the soil bugs which breakdown organic S may not be active and hence the pool of sulphate S can become depleted and is not restored via mineralization. For this reason ammonium sulphate is more effective that straight urea at this time of the year.

**Pasture S requirements**

For S the normal distinction between capital and maintenance inputs does not apply. This is because the amounts of S to eliminate the most severe S deficiency are similar to the amounts required to maintain soil S levels.

Fertiliser S requirements for optimal pasture production are based on two soil loss (mainly leaching loss) categories as shown below (ASC is the Anion Storage Capacity – the ability to store the negatively charged nutrient phosphate and sulphate).

<table>
<thead>
<tr>
<th>Soil category</th>
<th>Soil groups</th>
<th>Typical properties</th>
<th>Fertiliser S required for maximum production and maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>High loss</td>
<td>Pumice, Peats, Podzols, Sands and Recent soils</td>
<td>Low ASC (&lt;60), high rainfall (&gt;1500mm), coarse texture, low organic S</td>
<td>40-50 kg S/ha/yr</td>
</tr>
<tr>
<td>Low loss</td>
<td>All other eg Sedimentary, volcanic</td>
<td>High ASC (&gt;60), lower rainfall (&lt;1500mm) high soil organic S</td>
<td>20-25 kg S/ha/yr</td>
</tr>
</tbody>
</table>
Forms of S fertiliser

There are two forms of S fertiliser: Sulphate S and Elemental S.

Sulphate S: This is the form of S found in superphosphate and sulphate of ammonia. It is readily available to the plants and like K is mobile.

Elemental S: Elemental S is not immediately available to the plants (nor is it prone to leaching). It must first be oxidised by soil bacteria to the sulphate form. The rate of this process depends on the particle size, and soil temperature and moisture. To fully oxidise and become plant available in the year of application, elemental S must be finer than 250 micron in warm, moist upper North Island and less than 75 microns in the cool South.

Elemental S is the form of S in Durasul and Tiger 90. Durasul is cheaper that Tiger 90 but because of its particle size oxidises at about 50% per year. Elemental S is also found in sulphur-fortified superphosphate (Sulphur Super and Sulphur Gain). The conversion is elemental S to sulphate S produces acids. Thus when it is mixed with RPR to provide S the liming effect of the RPR is offset by the acidity from the oxidation.

Elemental S or Sulphate S?

Sulphate S is mobile and can leach. Elemental S and organic S do not leach. Thus the choice of product depends on the leaching risk factors. For free draining soils under high rainfall (> 1500 mm annually) and with a low ASC (< 20) adding at least some of the annual S requirement as elemental S is good practice. The sulphur fortified superphosphate is ideal for this purpose.

For all other situations sulphate S or elemental S are just as effective providing the elemental S is fine enough (see above). Durasul oxidises at about 50% per year so if the requirement is for 50 kg/ha of available S then 100 kg Durasul/ha is required.

Split versus single applications

Trials show that only on peat and pumice soils is there an advantage in splitting your S application between Autumn and Spring. On other soils there is no benefit in terms of pasture growth.

Animal health

There is an interaction between copper (Cu), molybdenum (Mo) and S, at least in animals feed on mixed rations. On pastures it is known that excessive Mo in pastures (> 1.0 mm in mixed pasture) can inhibit the utilization of Cu in animals and in the extreme induce Cu deficiency. It is not known whether excessive S exacerbates this problem when animals are on pasture. Pasture plants only take up the S they require for growth and it is rare to find S levels > 0.35%.


Pasture sulphur requirements, Fertiliser Review No 11 (www.agknowledge.co.nz/publications/TheFertiliserReview)