Potassium (K) is frequently referred to as potash or muriate of potash. It is cheaper than P (about $1.7/kg K) but is required in large amounts in NZ’s clover-based pastoral system. Clover has a higher requirement for all nutrients including K, relative to grasses. If K is deficient it will limit clover growth and production and the pasture will become very patchy with prominent urine patches. Clover growing in the K rich urine patch will look more vigorous and abundant.

**Optimal soil K ranges**

Recent research has quantified the probability of getting a pasture response to K fertiliser in relation to the soil K level (Quick Test K, QTK). The probability decreases with increasing QTK up to about 10 suggesting that this is the level required to eliminate the risk of K deficiency limiting pasture and in particular clover growth.

It was believed that Sedimentary soils could be operated at lower QTK levels than Volcanic and Pumice soils because they contained Reserve K (TBK) not measured by the QTK method. However the data above and other research (see Additional reading) shows that the Sedimentary soils are little different from the Volcanic and Pumice soil, which contain no Reserve K.
After taking into account the variability in QTK readings and the economics of using K fertiliser the target ranges for QTK on dairy farms have been revised accordingly.

<table>
<thead>
<tr>
<th>Soil group</th>
<th>Optimal soil QTK range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volcanic, Pumice, Sedimentary, Peats, Podzols</td>
<td>7-10</td>
</tr>
</tbody>
</table>

There is an important qualification to make; on some soils which are coarse, free draining, with a low cation exchange capacity (CEC – the ability of the soil to retain cations) and under high rainfall (This would include some Peats, Pumice Podzols, Sands and Recent soils) it is impossible to increase QTK levels irrespective of how much fertiliser K is applied. In these circumstances the QTK soil test is of little value and the only way to assess the need or otherwise for fertiliser K is to a) visually assess the pastures and in particular their clover content and b) collect clover-only samples for analysis (see Farmfact 7-4. Pasture testing)

**Increasing soil K levels**

Large inputs of K, over and above maintenance, are required to increase the soil QTK as shown below.

<table>
<thead>
<tr>
<th>Soil group</th>
<th>kg K/ha to increase QTK by 1 unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volcanic</td>
<td>60 (45-80)</td>
</tr>
<tr>
<td>Pumice</td>
<td>45 (35-60)</td>
</tr>
<tr>
<td>Sedimentary</td>
<td>125 (100-250)</td>
</tr>
</tbody>
</table>

There is a considerable range in these figures so the best practice is to apply the estimated amount of capital K and then monitor the changes in QTK over time adjusting the ongoing K inputs accordingly.

**Maintaining soil K**

Annual inputs of K are required to make good the losses of K from the farm (Losses included removal of products from the farm, transfer of K to non productive areas and leaching losses) Maintenance inputs range from 40 kg K/ha/yr. (range 0-70) to maintain QTK of 4 increasing to 200 kg K/ha/yr. (range 150-250) to maintain QTK 10.

Maintenance K inputs should be determined using OVERSEER for any given farm situation. In practice providing there is a good soil test monitoring program (see Farmfact 7-3 Soil testing) on going inputs of maintenance K can be altered to ensure that the QTK levels are in the range 7-10.

**Timing of K applications**

Relative to P, K is a mobile nutrient and it can (not will) be leached. This does not mean that if it rains shortly after K is applied it will all be leached. On an annual basis leaching losses may at worst be 10% - 20% of that applied.

If the soil is K deficient, capital K should be applied as soon as possible irrespective of the seasons. The sooner the deficiency is eliminated the better. The tradition on dairy farms is to apply 50% of the annual maintenance in autumn and the balance in spring. This is good practice because it a) minimizes the risk of K being leached during the winter and c) minimizes the problem of luxury uptake (see next section).
Animal health issues

When K deficiency is corrected there is normally a large increase in the clover content of the pasture. This may result in more bloat and hence all the appropriate precautions should be taken. Eventually the soil N level will increase (from the large inputs of clover N) and the pasture will settle back to normal (about 30% clover and 70% ryegrass is the ideal).

Pasture plants can take up ‘luxury’ amounts of K. This arises because K is required, not just for the growth of the plant, but also to balance the negative change arising from the uptake of all the other nutrients. Thus large inputs of fertiliser K can produce high concentrations of plant K (> 5%), which may upset the Mg and Ca metabolism of the lactating cow.

In a 3 year farmlet trial in Taranaki on a soil with a QTK of about 8, different rates of K fertiliser (0, 50, 150 and 380 kg K/ha/yr. had no measured effect on MS production, reproductive perform or metabolic disorders. This would suggest that the possible detrimental effects of potash on animal health are a myth. Nevertheless caution should be noted.

There are several strategies to avoid this problem arising:

1. Do not apply fertiliser K if the QTK levels is > 10-12
2. Do not apply the spring potash until after calving and mating
3. Ensure that the “transition cow” practices are implemented.
4. Increase the size of the effluent block so that the soil QTK levels are no increasing above 10-12.

Common Potassium fertilisers

<table>
<thead>
<tr>
<th>Name</th>
<th>K content</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potassium chloride (muriate of potash)</td>
<td>50%</td>
<td>Most common K fertiliser applied to pasture. Usually mixed with other fertiliser, e.g. 15%Potash Super has 15% MOP and 85% superphosphate.</td>
</tr>
<tr>
<td>Potassium sulphate (Sulphate of potash) or</td>
<td>42%</td>
<td>Also contains 17% sulphate S. More expensive per unit K than MOP. Used mainly on horticultural crops sensitive to chloride.</td>
</tr>
</tbody>
</table>

Further reading
Edmeades, et al., 2010. The diagnosis and correction of potassium deficiency in New Zealand pastoral soils: a review. NZ Journal of Agricultural Research. 53: 151-173

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