Managing mineral balance in sheep grazing cereals

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Background

The grazing of annual wheat has experienced widespread and rapid adoption

Forage is high energy, high protein, high forage and livestock growth

Higher winter carrying capacity (2100 to 3500 SGD/Ha), greater animal production (about 20 to 54%), minimal grain yield penalties (mgmt.), more pasture growth (40%)

Masters & Thompson (2016)
Fill the winter feed gap x sheep prices = lambing ewes
The problem

Wheat forages are deficient in sodium (Na), marginal in calcium (Ca) and magnesium (Mg), and excess in potassium (K)

Excessive K and K:Na impairs active absorption of Mg and Ca in the rumen, reducing growth rate and increases health risks for ruminants

Epithelial ion pump

Health risks are grass tetany, milk fever & bone disorders, higher for long-fed lambs, twin-bearing ewes and older pregnant / lactating ewes
The effect of potassium on magnesium

1% change in dietary potassium %

= 10% change in magnesium absorption

Suttle (2010)
### Table 4. Correlation matrix between mineral concentrations in soil and forage

Significant correlations are shown in bold

<table>
<thead>
<tr>
<th></th>
<th>Calcium (Ca)</th>
<th>Magnesium (Mg)</th>
<th>Sodium (Na)</th>
<th>Potassium (K)</th>
<th>Exchangeable Ca</th>
<th>Exchangeable Mg</th>
<th>Exchangeable Na</th>
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</thead>
<tbody>
<tr>
<td>Forage</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Ca</td>
<td>1.00</td>
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<tr>
<td>Mg</td>
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<td>1.00</td>
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<td>Na</td>
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<td>K</td>
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<td>-0.49</td>
<td>1.00</td>
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<td></td>
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<tr>
<td>Soil</td>
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<td>Exchangeable Ca</td>
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<td>Exchangeable Na</td>
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<td>Colwell K</td>
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<td>-0.64</td>
<td>-0.75</td>
<td>0.43</td>
<td>0.43</td>
<td>0.66</td>
<td>-0.33</td>
</tr>
</tbody>
</table>

Masters et al. (2018)
The current solution

Lime, Causmag and Salt is the typical supplement

How much?

*ad libitum* at a ratio of 2:2:1 (volume), or 1:1:1 (weight)

How much per head?

*ad libitum* or 10 g of each (30 g/day)

Increase animal growth rate (0-60%)
System solution

Biculture forages, of which one component is high in Ca, Mg and Na.

Potential sustainability benefits
- Animals graze with lower health risks
- Improve animal performance
- Lower cost of production

For example, lucerne is rich in Ca, has adequate Mg, better Na than the wheats. (but still deficient)
Hypothesis

Adding lucerne to the diet of lambs grazing wheat or perennial wheat will improve the metabolic status of Ca & Mg
Forage cut daily
This is 600 g DM,

So we fed two to three times each day

0.9 to 1.4 kg DM intake
Lambs fed individually

- Feed intake
- Lamb growth rate
- Palatability
- Mineral balance effects
Weekly blood and urine collection
Forage mineral content

Large dietary differences due to treatment
Extremely deficient in Na (0.06%)
Plasma mineral content

Large differences due to time but not treatment
Deficient in Na

Marginal in Mg

Adequate Ca

Marginal in P
Urine mineral excretion

Some differences due to time but not treatment
Take home messages

Adding lucerne to wheat:

Increases dietary Ca, Mg and Na intake, and feed balance ratios (not shown),

but did not improve plasma or urine minerals

Plasma Mg and forage Na the real threat
Take home messages

Increased plasma Ca, without change in urine Ca is difficult to explain (homeostasis; more lab tests required)

Hypothesis rejected:
Lucerne doesn’t solve the problem on its own. We still need Na and Mg with lucerne... but not calcium

Wheat only diets: Suppl. 15 g salt + 12 g MgO + 10 g Ca (40g/day)
THANK YOU FOR YOUR ATTENTION

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