Potassium uptake in plants and its relationship to grass tetany

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Summary

Changes in soil nutrient concentrations, particularly potassium cation levels, during plant growth, can give an indication to the degree of hazard that soil presents for the development of grass tetany in cattle.

Where the K/Mg + Ca ratio > .09 measured in c.mol/kg then a dangerous hazard exists for grass tetany to occur.

Introduction

The three main exchangeable cations involved with grass tetany in cattle are potassium (K), magnesium (Mg) and calcium (Ca).

Grasses, when actively growing, tend to absorb more potassium relative to calcium and magnesium. Potassium, being a more strongly held element, tends to displace the less strongly held calcium and magnesium when all are freely available.

Mineralisation in the soil allows replacement calcium, magnesium and potassium cations to make up the difference of those cations removed by the plants while they grow.

The mineralisation within the soil tends to be constant compared to plant growth which can fluctuate depending on species and weather conditions.

It is known that high levels of potassium in the plant, interferes with magnesium absorption in the rumen, causing grass tetany. Elliott M (2001).

How much potassium is taken up by the plant relative to magnesium and calcium can be measured by analysing the soil pre and post plant growth, in the top 10 cm of soil where the majority of K will be absorbed by the plant roots.

Measurement and Methods

Soil was collected in the Goulburn area from a paddock where consistent clinical cases of grass tetany in cattle occurs.

Samples of soil using a transect sampling procedure in the 0-10 cm depth range were collected pre and post plant growth. During the growth phase cattle grazing the pasture (mixed ryegrass, phalaris, cocksfoot) exhibited hypomagnesaemia and some deaths due to grass tetany.

The soil was then analysed (see Table 1) by determination of cation exchange capacity and exchangeable cations by silver thiourea. Elliott M (2001)

Results

Table 1. Changes in soil nutrient concentration (c.mol/kg). Concentrations of calcium (Ca), magnesium (Mg) and Potassium (K) and the K/Mg + Ca ratio before and after plant growth, in soil collected from a paddock where clinical cases of grass tetany have been observed.

Soil Mineral Results		
Mineral	Pre Plant Growth	Post Plant Growth
Calcium (Ca)	10.5	10.7
Magnesium (Mg)	4.63	4.95
Potassium (K)	1.60	1.07
K/Mg + Ca	0.11	0.07

Discussion and Conclusions

The first thing to note is that the K/Mg + Ca ration in the soil 0.11 c.mol/kg is above the dangerous ratio for soil cations, as a risk for grass tetany. Elliott M (2001).

Since clinical cases of grass tetany occurred in cattle on that same soil in the paddock, it is interesting to note that:

1. Calcium levels after plant growth had increased in the soil.
2. Magnesium levels after plant growth has increased in the soil.

3. Potassium levels had markedly decreased after plant growth in the soil.
4. The K/Mg + Ca ratio had decreased from the dangerous > .09 level to the marginal level of hazard .07.

Calcium and magnesium levels of the soil pre plant growth are considered to be adequate for a sandy clay loam with a pH of 6.4. The soil calçium and magnesium levels increased marginally after plant growth and no deficiency symptoms were exhibited in the plants.

Potassium on the other hand was freely available in the soil and since the post growth soil contained less potassium, then it is likely that the potassium was taken into the plant and available to the grazing cattle via the plant leaf tips.

Cllinical cases of grass tetany were observed in the grazing cattle and it is likely that this was caused by potassium from the leaves interfering with magnesium absorption in the rumen of the cattle. Elliott M (2001)

Reference

Reference: Elliott (2001) Grass Tetany in NSW, M.Sc.(Hons) Thesis, University of Western Sydney.