SIP

SUSTAINABLE INTENSIFICATION RESEARCH PLATFORM

Enhanced Environment

Increased Farm Performance

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SCIENCE, POLICY AND PRACTICE NOTE 4

Sustaining Trace Elements in Grazing Sheep

The Issue

Sheep systems generate high quality protein outputs from land that is often unsuitable for other forms of agricultural production. Grass leys are also increasingly being adopted in arable rotations as a means of weed control and soil improvement. In many grazing situations, the only nutrients that a sheep will receive are from the pasture, with no supplementary/additional feed. Whilst this reduces costs, it may compromise production if sheep become deficient in the **trace elements** needed for development, growth, and the health of the flock. A sheep's requirement for trace elements varies throughout the year (e.g. with higher levels required to raise fertility, or when lambs are undergoing rapid muscle development during growing). It is also known that trace element levels vary in grass according to a number of factors, including season, soil type and pH, and the plant species being grazed.

Trace Elements – minerals within the body in mg/kg concentrations rather than the g/kg quantities for macro elements (Ca, P, Mg, K, Na etc). Some of these are essential for normal function and the major elements of issue in sheep are cobalt, selenium, copper and Iodine. Trace elements are in not actively stored and rely on dietary supply and passive storage via elevated status and tissue turnover.

SIP's Response

Our work aimed to explore the seasonality within grazed pasture and leys of the key trace elements for sheep production:

- **cobalt** for ruminal synthesis of vitamin B12, which is required for propionate and one carbon metabolism; deficiencies of which will result in a loss of appetite, decreased growth rate and conditions such as pine where sheep show depraved appetites (eat soil, etc.);
- **selenium** plays a key role in antioxidant function, with deficiencies resulting in decreased immunity, production and ultimately conditions such as white muscle disease;
- **copper** has roles in immune function, wool growth and energy metabolism; copper deficiency during gestation can cause swayback. Copper toxicity is another consideration, especially for sheep as different sheep breeds are less tolerant of high copper e.g. Texel, whilst others are more likely to have deficiency issues e.g. Swaledale. Copper toxicity can be an especial problem at post grazing housing. We also monitored the elements (iron, sulphur and molybdenum) that can interact with copper – it is the sudden decrease in iron at housing along with potential increase in copper due to other feeds than can cause the toxicity.

Simulated grazing samples (see Figure 1) were collected on 17 occasions from 15 fields on one farm across two grazing seasons (2015-16) and these were analysed for trace element composition by ICP-MS after microwave acid wet digestion. Blood samples were taken from un-supplemented sheep to compare their trace element status with the concentrations in the grazed pasture.

Figure 1: "Pinch" sampling of pasture. The gloved hand (to prevent contamination of samples) pinches grass to be 'grazed' which is 'bitten' off using the scissors and collected. Grass collected should be representative of what is being grazed e.g. avoid areas of faecal and urine soiling and plants not readily consumed.

What SIP Learnt

We found that the trace element status of the sheep grazing the pasture is dependent on the trace element composition of the pasture.

Previous nutrition also had a carry-over effect. Most of the sheep sampled were housed prior to lambing, and fed a ration containing trace elements. The elevated selenium and cobalt status from consuming the mineralised ration whilst housed was able to ameliorate the effect of low selenium and cobalt pastures in the spring after turnout. There was a slow reduction in the elevated glutathione peroxidase activity and vitamin B12 concentrations in response to the marginal grazing status.

The cobalt status of the sheep was low in the summer into the early autumn, reflecting the low cobalt status of the grazed ryegrass at this time of year. The selenium status of grazed grass was generally below requirements and selenium status was marginal in most fields.

Work in association with Bangor University showed that although pasture improvements (fertiliser application, liming, and re-seeding) improved grass yield (hence could increase sheep stocking density), they lowered the trace element status of the pasture (decreased manganese, zinc and copper, with increased molybdenum and iron concentrations) and within the sheep grazing those pastures (decreased zinc, cobalt, manganese and selenium status at weaning).

In summary:

The time of year affected the trace element composition of grass:

- We found that cobalt levels were lower in summer/early autumn and higher in spring
- Iron levels were similarly higher in early spring and late autumn. Iron interacts with copper and sulphur to reduce copper availability within the rumen and beyond lowering absorption and allowing more thiomolybdate toxicity

The weather affected trace element composition of grass:

- Cobalt concentrations in grass were lower in the dry spring of 2015 (~70-90% of 1981-2010 rainfall average), compared to the wet spring of 2016 (~110% of 1981-2010 rainfall average)

The sward species composition affected the trace element status of grazing sheep:

- Pastures containing white and red clover had higher cobalt concentrations than predominantly ryegrass swards

How to improve the trace element status in grazing sheep

Targeted supplementation of trace elements that are shown to be deficient in the grazing and/or in the animal can be beneficial to livestock performance. However, it is important to remember that supplementation beyond adequate status is unlikely to yield any further benefits and is only going to add to costs. Analysing the trace element status is therefore of importance prior to any form of supplementation.

The trace element status of the animal (through blood sampling) reflects recent history, whilst grass analysis tells us about the levels in the forage that they are about to eat. It may be useful to compare across seasons and years to identify the times when trace element levels fall to a point where supplementation can be justified, or where a natural increase in levels is to be expected in the pasture, and supplementation may not be required. For example, we found cobalt status was low in animals and pasture in early autumn, but we saw a late autumn increase in cobalt concentration of the pasture (Figure 2) and a corresponding increase in the cobalt status of the animal.

The application of a trace element bolus is regarded as the most reliable form of supplementation. However, it is not the only option as changes in management regimes can be effective such as grazing swards that include clovers to enhance mineral content (clovers have a higher summer cobalt concentration than ryegrasses).

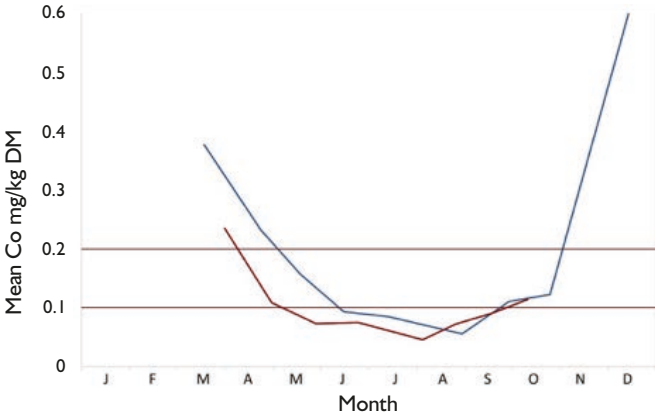

Figure 2: Mean cobalt concentrations (mg/kg DM) for predominantly ryegrass pastures (permanent and a new ley) for 2015 (red) and 2016 (blue). The lower cobalt concentration in the spring of 2015 correlates with a dryer spring. The horizontal lines are the recommend cobalt requirements for sheep as published by NRC (National Research Council, USA) which are used as industry standards in UK.

Opportunities for Policy and Practice

Ensuring adequate levels of trace elements is an important and often over-looked part of efficient sheep production systems. However, given the many factors that influence sheep trace element status, it is often difficult to determine whether supplementation is needed and therefore whether it can be justified. This applies in a range of grazing systems from short-term arable leys to upland pasture. This work has further confirmed the importance of sampling and analysing trace element levels in sheep before taking measures to supplement. It has also shown the clear correlation between trace element levels in sheep and the pastures that they graze.

Auditing the flock to determine trace element status is relatively easy, but should involve a team of farmer, nutritionist/consultant and farm vet. The team can then determine which fields and animals need sampling and it should be remembered that sometimes the results are more relevant to the time around sampling next year than when results are received this year – it should be an ongoing process building on history and can be included in the flock health plan.

Authors

Nigel Kendall (University of Nottingham), Chris Stoate (Game and Wildlife Conservation Trust), Prysor Williams (Bangor University)

Further Resources

Kendall, N.R. and Bone P. (2017) *Farm and laboratory assessment of mineral availability in ruminants*. In: Recent Advances in Animal Nutrition 2015 (Eds Garnsworthy, P.C. and Wiseman, J.) In Press

Kendall, NR and Bone PA (2014) 'Sheep mineral supplements: what do they do and when should they be used?' *Animal Health Advisor* August 6-8

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The Sustainable Intensification Research Platform (SIP) is a multi-partner research programme comprising academia, farmers, industry experts, environmental organisations, and policymakers.

Funded by Defra and the Welsh Government, the platform explores the opportunities and risks of Sustainable Intensification (SI) from a range of perspectives and landscape scales across England and Wales.

The Platform, run from 2014-17, has investigated ways to increase farm productivity, reduce environmental impacts, and increase the benefits that agricultural land provides to society.

SUSTAINABLE INTENSIFICATION RESEARCH PLATFORM

More Information

Visit: **www.siplatform.org.uk**

Contact: Nigel Kendall (University of Nottingham)
Nigel.Kendall@nottingham.ac.uk

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