Trace element supplementation of lambs post weaning

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Achieving high levels of lamb performance from grazed pasture in mid-season systems of prime lamb production is necessary to minimise costs of production. A high level of lamb performance is achievable from grazed grass offered as the sole diet. However, many producers are unable to finish lambs from grazed grass alone. Whilst the reasons for this inability are likely to include poor grassland management and parasite control, trace element (mineral) deficiency can be an issue in some sheep producing areas in Ireland. It is known that the concentration of trace elements in pasture varies during the grazing season.

Trace element deficiencies can be inherent (low concentrations in the soil) or induced (uptake restricted by another trace element). Deficiencies may be expressed either in a clinical (symptoms present) or subclinical (no obvious symptoms) form. However subclinical deficiency may reduce lamb performance and thus can be economically important.

In Ireland the main trace elements of concern include cobalt, selenium, copper and iodine. Cobalt deficiency is the most common.

The primary objective of this paper is to present information from a study undertaken at Athenry on the effects of trace element supplementation on lamb performance post weaning.

Lamb performance post weaning

Good grazing management will deliver high levels of lamb performance from grass post weaning, be it from a new reseed or old permanent pasture (Table 1).

Table 1 Effect of sward type on lamb performance

	Sward type					
	Perennial ryegrass (PRG)	Tyfon + PRG	Tyfon only	Chicory + PRG	Chicory only	Old permanent pasture
Live-weight gain (g/day)						
- weeks 1-3	308	244	184	240	167	284
- start to finish	226	220	213	190	226	219
Carcass weight (kg)	19.0	18.9	19.0	19.6	19.8	19.0

(Keady and Hanrahan 2010)

To achieve the best level of lamb performance from grazed grass, pasture must be managed to maximise the proportion of leaf in the sward canopy, therby maintaining herbage digestibility and intake potential. This is achieved during the post-weaning period by grazing swards to a target post grazing sward height of 6 cm. However when lambs are removed from the paddock, dry ewes can be used to graze the pastures down to 4 cm, thus ensuring a leafy re-growth for lambs on the next grazing rotation. If grazing after-grass lambs can be let graze down to 5 cm prior to moving.

In recent years there has been interest in the inclusion of alternative forages in grass seed mixtures sown in late May for grazing by lambs post weaning. Results from a study at Athenry showed that neither tyfon or chicory, offered as the sole forage or in combination with perennial ryegrass, had beneficial effects on lamb performance relative to a new perennial ryegrass reseed or to well-managed old permanent pasture.

Athenry trace element supplementation study

A study was undertaken recently at the Athenry Research Centre to evaluate the effects on lamb performance post weaning from supplementation with cobalt, either alone or in combination with vitamin B_{12} and selenium.

Selenium deficiency is associated with poor lamb performance and white muscle disease. Selenium is also important for immune function. Its metabolism is closely related to vitamin E which acts as an antioxidant.

Cobalt is required by animals in the synthesis of vitamin B_{12} which is essential for the metabolism of a rumen volatile fatty acid (propionate) which is an important energy source to ruminants.

Symptoms of deficiency include loss of condition, poor fleece quality, ears become dry and scaly (photosensitisation), loss of appetite, runny eyes with tear staining on the face, and higher worm counts (immune suppression). The uptake of cobalt by plants from the soil can be restricted by high concentrations of manganese and by high soil pH. As cobalt is not stored in the body and is needed in the rumen, a continuous supply is required throughout the grazing season for vitamin B_{12} production. Vitamin B_{12} is absorbed from the small intestine and stored in the liver.

At weaning lambs were divided into three groups and received either no supplementation or were supplemented with cobalt or a combination of cobalt, vitamin B_{12} and selenium. The lambs received their treatments, by drench, every 2 weeks. All lambs were grazed as one flock to remove any possible effects of grazing management on lamb performance. In addition all lambs received the same anthelmintic treatments. The study commenced in mid-July and finished when the last lambs were drafted for slaughter in mid-December.

The effects of treatment on lamb performance are presented in Table 2. During the first 7 weeks of the study trace element supplementation had no effect on daily live-weight gain. However as the grazing season progressed supplementation with cobalt, offered either alone or in combination with vitamin B_{12} and selenium increased lamb weight gain. Consequently trace element supplementation increased lamb drafting weight and carcass weight by 1.75 kg and 1.35 kg, respectively. It is notable from these results that there was no benefit to including vitamin B_{12} and selenium with cobalt in the drench under conditions of the Athenry farm.

Table 2. Effect of trace element supplementation on lamb performance

	Treatment		
	Control	Cobalt	Cobalt + B_{12} + selenium
Live-weight gain (g/day)			
-12 July to 26 August	179	179	172
-26 August to 23 September	169	193	237
-23 September to 4 November	81	150	159
-4 November to 16 December	113	212	172
Weight at drafting (kg)	45.6	47.2	47.5
Carcass weight (kg)	19.1	20.3	20.6

(Keady, Fagan and Hanrahan 2015a)

Blood samples were taken from the lambs that were drafted for slaughter on 4 November and 16 December and the results are presented in Table 3. These data show that lambs on all treatments were in the normal range for blood copper, selenium and GSHPX (glutathione peroxide). Furthermore, of all the lambs that were blood sampled only one lamb had blood copper concentrations (9.3 mmol/l) below the normal range (9.3 – 19 mmol/l) while 10% of lambs were above the normal range. Similarly, only 4 lambs had blood selenium concentrations below the normal range (0.75 – 3.0 µmol/l); the lowest was 0.61 µmol/l. However, including selenium in the trace element mixture increased blood selenium concentration.

Table 3 Effect of trace element supplementation on blood composition

	Treatment		
	Control	Cobalt	Cobalt + B_{12} + selenium
Copper (mmol/l)	16.7	15.5	16.0
Selenium (µmol/l)	1.0	1.0	1.7
GSHPX (units/ml)	154	162	292

(Keady, Fagan and Hanrahan 2015b)

Currently there is no accurate measure for blood cobalt concentration available in Ireland. As cobalt is stored in the liver in the form of vitamin $B_{12,}$ the best indicator for cobalt status is liver cobalt concentration. The effects of treatment on liver and kidney composition are presented in Table 4. Lambs that did not receive any supplementation had a lower concentration of cobalt in the liver, being below the normal range. Supplementation with cobalt alone or in combination with vitamin B_{12} and selenium increased liver cobalt concentrations. Inclusion of vitamin B_{12} tended to increase liver cobalt concentration relative to the cobalt only treatment.

Kidney selenium levels were also measured. Including selenium in the drench had no effect on kidney selenium concentrations. Lambs which had been supplemented with cobalt alone or in combination with vitamin B_{12} and selenium had higher liver copper concentrations which may be due to higher herbage intakes.

Table 4. Effect of trace element supplementation on tissue composition

	Treatment		
	Control	Cobalt	Cobalt + B_{12} + selenium
Liver			
-cobalt (μmol/l)	0.17	0.73	0.99
-copper (μmol/l)	1.45	1.81	1.66
Kidney			
-selenium (μmol/l)	17.8	17.5	16.8

(Keady, Fagan and Hanrahan 2015b)

Conclusions

1. At Athenry, supplementation with cobalt increased lamb performance.
2. The benefit to supplementation was greater later in the season
3. Including vitamin B_{12} and selenium with cobalt did not significantly increase lamb performance relative to the cobalt only treatment

Science to practice

1) To improve lamb performance post weaning it is important to
   - **a)** Use good grassland management practices.
   - **b)** Implement an effective parasite control regime
2) If a trace element deficiency is suspected on clinical signs it needs to be identified by
   - **a)** Blood samples (currently there is no blood sample for cobalt)
   - **b)** Tissue samples (liver for cobalt deficiency)
3) Soil sampling can be a poor/inadequate indicator of trace element deficiency in lambs because
   - **a)** Some trace elements restrict the uptake of others by plants, e.g., manganese interferes with the uptake of cobalt
   - **b)** Soil pH effects mineral uptake e.g. a high soil pH limits cobalt uptake by herbage.