

Project number: 6387
Funding source: Teagasc

Date: December 2020
Project dates: Jan 2013-Dec 2016

The trace mineral status of Irish swards, and the effect of trace mineral supply on the reproductive performance of dairy cattle



Key external stakeholders:

Dairy farmers
Scientists
Dairy advisors
Stakeholders in the cattle breeding industry
Veterinarians

Practical implications for stakeholders:

- Examined seasonal variation in concentrations of macro- and micro-minerals in grazed grass and in the total diet of lactating dairy cows on 44 dairy farms dispersed across the main dairy regions in Ireland.
- Examined effects of trace mineral bolus supplementation on cow reproductive performance.

Main results:

- A grass-only diet is inadequate for many important minerals for both health and reproduction. Dairy farmers need to be aware that on a grass-only diet, the dietary supply of certain minerals is likely to be inadequate. Large variation occurred both within and across the farms sampled, highlighting the need for regular auditing of grass and total diet mineral concentrations, and appropriate supplementation strategies established to deal with any deficiencies or imbalances identified.
- Providing cows with a trace mineral bolus at different times (at dry-off, at 6 weeks before the breeding season began or at both times) did not affect the main fertility KPI's in grazing dairy cows.

Opportunity / Benefit:

The results are important for all dairy farmers, especially those focused on maximizing the proportion of grazed grass in the cow's diet. When grazed grass is imbalanced for one of more minerals, it is important to identify a strategy to provide supplemental minerals to optimize cow productivity, health and welfare.

Collaborating Institutions:

University College Dublin

Teagasc project team:

Stephen Butler (PI)
Francis Curran
Hazel Watson
David Wall

External collaborators:

Pat Lonergan (UCD)
Alex Evans (UCD)

1. Project background:

As grazed grass is the predominant feed in Irish dairy production systems, knowledge of its full nutritive value is essential. A mineral is considered essential if its deficiency results in an impairment of function. While clinical deficiencies of macro-minerals or trace minerals in dairy cattle are rare, subclinical deficiencies are common and can manifest in a range of symptoms that depend on the extent and duration of deficiency. These include poor reproductive performance and suboptimal animal health.

Trace mineral supplementation to dairy cattle in Ireland has been inadvertently reduced in recent years as concentrate inputs (normally enriched with trace minerals) have been curtailed to maximise utilisation of pasture during lactation. The requirement for a trace mineral can be defined as the amount that must be absorbed daily to maintain optimum cow health, milk production and reproductive performance, while also ensuring that adequate body stores of minerals are maintained.

Mineral deficiencies in grass depend on region, season, soil pH and moisture content, plant variety and fertilisation strategy, and can translate into deficiencies in the grazing cow. Even under controlled conditions, pasture herbage varies in mineral content over a grazing season.

2. Questions addressed by the project:

- What is the seasonal variation in grazed grass and total diet mineral profile in Irish pasture-based dairy herds?
- Does trace mineral bolus supplementation affect reproductive performance in lactating dairy cows?

3. The experimental studies:

Study 1:

- This study had two primary objectives; (i) benchmark the seasonal variation in pasture mineral concentrations and (ii) determine the mineral nutritive value of both grazed grass and the total diet for lactating dairy cows.
- Spring calving dairy farms (n = 44) were selected based on region and soil type and enrolled on the study. Each farm was visited once in March, May, August and October 2013 and January 2014. At each visit, the grass samples and samples of any other feeds being consumed (silage, concentrate and other miscellaneous feedstuffs) were collected and the proportion of each feedstuff in the diet was recorded. The daily grass samples were then mixed to form one composite sample, representative of grass offered to the herd during the preceding week. All samples from each farm were analyzed for mineral concentrations using inductively coupled plasma mass spectrometry (ICP-MS).

Study 2:

- This objective of this study was to examine the effects of slow release trace mineral (TM) bolus supplementation on blood indicators of TM status and reproductive performance in dairy cows managed under a primarily pasture-based system.
- In total, 1,381 animals on 5 farms were enrolled in the trial. Within each farm, cows were randomly assigned to one of 4 treatments: CONTROL (no bolus); DRY (bolus at dry-off); BREED (bolus 6 weeks before mating start date (MSD)); DRY_BREED (boluses at dry-off and 6 weeks pre-MSD). Boluses contained 30 g copper (Cu) oxide, 3400 mg iodine (I), 500 mg selenium (Se), and 525 mg cobalt (Co).
- Blood samples were collected from 10 cows per treatment on each farm at 6 strategic time points and were analysed for plasma concentrations of Cu, Se and inorganic I (pil).
- Herd breeding records and ultrasound scanning results were collated and reproductive variables calculated.

4. Main results:

Study 1

- Pasture mineral concentrations did not vary greatly over the four sampling points, with the exception of selenium, the concentrations of which were greater at the first sampling time point (0.21 ± 0.18 mg/kg) compared to all other sample collection times (0.04 ± 0.03 , 0.07 ± 0.04 , 0.03 ± 0.04 mg/kg on visits 2, 3, and 4, respectively).
- A pasture-only diet would have provided on average (range in parentheses), 90% (45-130), 80% (30-125), 50% (8-190), 65% (30-77) and 30% (3-108) of the requirements for lactating cows for P,

Cu, I, Zn and Se, respectively. When total dietary mineral intakes were estimated, on average, the diet provided 96%, 153%, 359%, and 58% of the lactating cow requirements for P, Cu, Zn and Se, respectively. When concentrate supplements were fed (March, May), iodine was generally over-supplied in the total diet, with average estimated intakes exceeding 400% of requirements.

- We conclude that, on average, pasture grown on Irish dairy farms is inadequate for P, Cu, I, Zn and Se to meet cow requirements when fed as the sole feed.

Study 2

- Bolus supplementation of trace minerals increased plasma inorganic iodine and selenium, but plasma copper was not affected by treatment.
- For much of the study, plasma concentrations of copper, selenium and iodine were within the normal range for all treatments, including CONTROL.
- The TM bolus is expected to last 6 months; however, the temporal profiles revealed that it lasted no more than 3 months.
- Trace mineral bolus supplementation had no effect on fertility variables.

5. Opportunity/Benefit:

- The results of study 1 indicate that grazed grass in Ireland can be deficient in several minerals. This could result in problems, especially during the summer months, when it is possible for many herdowners to operate a grass-only diet. Farmers need to benchmark the mineral nutritive value of the grazed grass on their farm and develop supplementation strategies to prevent animal mineral deficiencies.
- In the year of the survey (2013), a fodder crisis occurred. This resulted in greater concentrate feeding rates than normal. In many cases, minerals were over-supplemented as a result. It is important that the concentrate carries only the amount of minerals that the cow actually needs. Excessive mineral supplementation can result in excessive mineral concentrations in milk, which can render the resulting milk powder unsuitable for some potentially important high value markets (e.g., excess iodine in milk makes it unsuitable for infant milk formula).
- In well managed herds with normal feeding practices, supplementation with trace mineral boluses did not improve cow reproductive performance.

6. Dissemination:

International conferences

Presented at American Dairy Science Association Annual meeting (2016).

National Conferences and seminars

Presented at the Agricultural research Forum (2015) and Teagasc Moorepark Open Day (2015). **Main publications:**

- F. Curran, D.P. Wall, P. Lonergan and S.T Butler (2016). Survey of temporal variation in pasture mineral concentrations and total dietary mineral intake in pasture-based dairy herds. J. Dairy Sci. Vol. 99, E-Suppl. 1, p. 286.
- F. Curran, D.P. Wall, P. Lonergan and S.T Butler (2015). Survey of temporal variation in pasture mineral concentrations and total dietary mineral intake in pasture-based dairy herds. Proceedings of the 2015 Agricultural Research Forum, Tullamore.

Popular publications:

- Stephen Butler, Francis Curran and David Gleeson (2017). Purple patch. TRResearch, 12(4): 18-19.

7. Compiled by: Dr. Stephen Butler