Soil and Nutrient Network

Helping farmers improve soil and nutrient management

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Case study
Balwherrie Farm, Leswalt, Stranraer

Balwherrie is a beef unit owned and farmed by Ian and John Agnew. The 121ha farm is all grassland carrying 150 beef cows. The herd is predominantly Spring Calving with calves overwintered and sold at 15-18 months. 10% of the herd are pedigree Aberdeen Angus or Simmental used to breed stock bulls.

The farm sits 3 miles from Stranraer along the Loch Ryan peninsula; there are 3 main soil types, imperfectly drained red/brown clay loam on the upper slopes grading down to clay loam and a small area of Humous Peaty over clay loam at low levels. Balwherrie is mainly Class 3.1 capable of producing a moderate range of crops with good yields and some Class 3.2 which reflects some growth limitations.

Soil Structure

Compaction was found in a 40 acre silage field which had been ploughed and reseeded to grass in 2016 . The compaction was seen at a depth of 10-22cm and was characterised by poor root penetration and large blocky aggregates which did not break apart easily (pic A). Damage was most likely caused by heavy machinery trafficking from silage, muck spreading etc. and the high rainfall in 2017; it also appeared to match up with tracking as some strip areas had better structure (pic B). With a VESS score of Sq4 action was required to address this issue and an overall change in grassland management required to prevent further issues. Compaction can contribute to a number of problems including a reduction in crop productivity, poor nutrient utilisation resulting in a greater risk of run off and and water pollution, as well as increased nitrous oxide emissions.

After establishing the compaction depth it was concluded a swardlifter was the machine required to rectify the compaction.

A Spalding Flatlift was used to a depth of 25cm to loosen the soil. After this soil was loosened and was more friable. This should see improved grass growth, better soil drainage and ground conditions over the following months.

John will look at tyre pressures and crop options which will assist with opening the soil structure to prevent damage in the future.

For more information on the Soil and Nutrient Network see www.fass.scot, For dates of SNN events, find us on Facebook or follow us on Twitter @FASScot

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Phosphate and Nutrient Budgeting in Practice

Phosphate stimulates root development and encourages early growth. Cereals and newly sown grass and clover benefit from applied Phosphate as their roots are insufficiently developed to tap the main P reserves in soil. Although plants get phosphate from the soil, it must be converted to a soluble form before being absorbed by roots. Clover is more susceptible than grass to P deficiency due to having less extensive roots system, so grass out-competes. There is a lot of insoluble phosphate in the soil – only a small proportion is soluble at any time and used by plants.

Applying lime can increase the availability of stored soil P as well as freshly applied P in fertiliser. The availability of soil P is maximised at a pH of 6.5, with only 48% available at a pH of 5.5. Trials by Teasgasc showed that an application of 5t/ha of ground limestone produced a similar grass yield compared to the application of 40kg/ha of P, however the greatest grass yield response was seen when lime and phosphate were applied in combination.

The target soil status for phosphate is M- (M+ for clover); regular soil sampling will enable careful monitoring of soil levels and fertiliser applications can be tailored accordingly.

At Balwherrie, sampling results showed that over the last 3 years soil P levels in silage fields had fallen from a Moderate to Low status. A fertiliser budget highlighted that whilst N and K applied matched demand, the Phosphate applied was 50kg/ha below the recommended rate. An application of Triple Super Phosphate was made to correct this and the grade of NPK purchased will be altered to maintain this status.

Testing the nutrient value of slurry will also enable an accurate account to be made of the NPK being applied from organic manures.

Key Findings

Soil sample every 3-4 years to help nutrient budgeting for lime, Phosphate and Potash applications

When monitoring soil structure remember:

- **S**oil Assessment - Dig a hole and assess if action is needed?
- **T**iming - not too wet not too dry
- **A**ppropriate Machine - Aerator/Swardlifter or Subsoiler
- **R**ight Depth - the machine should be working 3-4cm below the compaction layer to effectively disturb soil and break the pan

Lime, lime, lime

Lime applications are needed to maintain soil pH which:

- Encourages soil microbiology (worms + N bacteria)
- Increases utilisation of nutrients by plants
- Increases availability of nutrients in fertiliser
- Enhances availability of phosphate in the soil
- Reduces risk of Aluminium toxicity
- Helps breakdown of Organic Matter
- Provide Calcium and Magnesium which help balance soil structure

% Nutrient Availability at different pH

	N	P	K
pH 5 (very strong acidic)	53%	34%	52%
pH 5.5 (strong acidic)	77%	48%	77%
pH 6.0 (medium acidic)	89%	52%	100%

There are significant reductions in fertiliser efficiency at lower pH as shown in table above. Annual losses in soil acidity come from rainfall, leaching, crop removal and nitrogen applications.

REMEMBER—Applications of 5t/ha every 5 years is required just to maintain a pH level.

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Controlled Traffic Farming

SRUC's Dr. Paul Hargreaves highlighted research carried out at the Crichton Royal Farm using controlled traffic farming techniques. Often considered an approach more relevant to arable farmers, Paul and his team have been looking at the improvements in yields achieved by adopting CTF for grassland operations.

A 7ha field was divided in two, half receiving controlled traffic practice (CTF) and half where conventional journeys were made. Measurements were taken of the soil conditions and grass yields from both field halves.

The study has shown improvements in grass yields of 13.5% for the 2nd & 3rd cuts of silage, totalling almost 1 t/ha. The changes were only introduced at the time of 1st cut, so the results can only be reported on the latter two cuts. When the soil profiles have been examined with a VESS, the structural damage has been prevented in areas between the tramlines. Over the silage season, the area travelled by machinery was 57% less in the CTF area than in the conventional field management area.

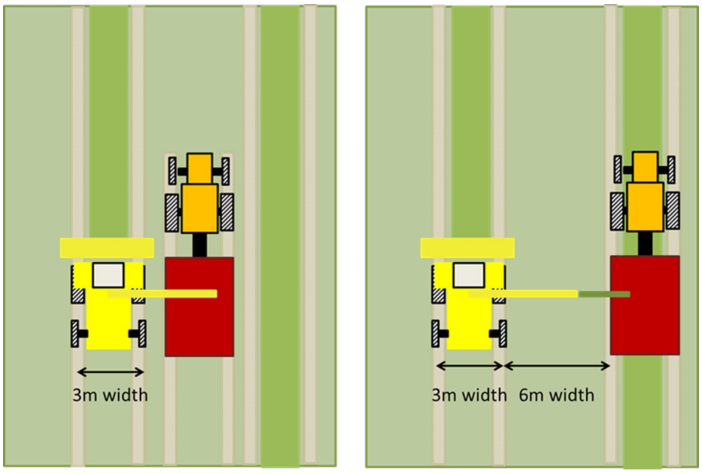

Fig 1. Controlled traffic working widths for silage production.

Paul's take home messages were:

- know you soil structure & improve where necessary to improve grass yields.
- Prevent over-trafficking to reduce damage to soil structure and crop production potential.

Do You Know Your Worms?

Earthworms are an excellent indicator of soil health and are often under rated. Worms integrate litter and organic matter from the top of the soil down to deeper levels, whilst bringing deeper soil to the soil surface. In doing so they create channels which are vital to allow airflow through the soil - something needed by plant roots; these channels also help with water infiltration, and prevent total water run off over the surface of the soil.

There are three main species of worms.

1. Epigeic worms - these are about 2-6 cm long and live on the soil surface, breaking down surface litter /organic matter into nutrients that can be used by the soil microbes. They are generally bright red or red-brown in colour but aren't stripy.
2. Endogeic worms - these pale, medium sized worms can be up to 18 cm long and are shallow burrowers. They burrow horizontally across the soil profile to move around and feed.
3. Anecic worms - these are the largest worms and can be up to 45 cm in length. These worms burrow vertically, moving soil up and down the profile. Their casts can be seen on the soil surface. They drag organic matter and leaves down from the surface into their burrows and are commonly found in grassland. These worms are dark coloured at the head end and have paler tails.

Find out more about worms from the Opal Guide to British Earthworms

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Managing Soil Minerals

Trace minerals are elements required by plants for several functions. Slight imbalances can affect crop growth and performance as well as have an impact on livestock feeding on the plants or forage.

Whilst a soil may not be deficient in trace elements, the availability of them for plant uptake may be compromised by factors such as soil pH, organic matter and soil drainage. The value of regular soil analysis and structural inspections can not be under estimated. By monitoring the chemical composition of soils farm nutrient budgets can be tailored to ensure that plant requirements are met, whilst regular assessments of the soil structure will provide early warning of any soil compaction or drainage problems which may affect nutrient uptake.

Lorna Galloway, SAC Consulting, led a short but informative session about managing mineral contents on grassland soils, with a particular focus on the role of Potassium and it's importance to a plant for cell structure, regulating water content, immunity and tolerance to stress. Relating this back to the results of analyses seen at Balwherrie where an additional cut of silage was taken during 2018, the soil analyses showed a large drop in Potassium levels where the K status dropped from M+ to L. Potassium deficiency is not an easy imbalance to identify without regular sampling because there are few visible crop signs. Whilst yellowing around the edges of mature leaves can be seen, this can also be attributed to other causes such as drought, water logging etc. Potassium is required to aid the uptake of Nitrogen by plants, it has an important role to play in fixation of nitrogen by legumes and plays a role in the conversion of nitrogen to protein, and so can affect the quality of forage for livestock.

The key message was to review the farm nutrient management budget regularly with support from regular soil tests. If a heavy crop of grass is harvested at silage time, revisit the nutrient budget and factor in a heavy off take of Potassium when planning future fertiliser applications. Test the value of slurries and manures prior to application to ensure that the crops will receive the necessary nutrients to ensure optimal plant growth.

Grassland Management For Animal Health

Local vet, Alistair McClelland, explained how careful grassland and grazing management can help to improve animal health.

There are a number of crop and soil borne diseases and parasites that can affect livestock, resulting in not only animal health and welfare problems, but reduced productivity and profitability, e.g. parasites, clostridial diseases such as blackleg and mineral imbalances such as. grass tetany.

Simple management practices such as using older stock and mixing livestock types will help to clean up parasitic loads on grazing ground after younger stock have been moved to different pasture. Rotating silage fields is another useful way to create 'clean grazing' free of parasites onto which youngstock can be grazed. Faecal egg counts are the most effective way to monitor parasitic loading within a herd or flock. The FAS website has videos to explain how and when to sample for faecal eggs in cattle and sheep.

For clostridial diseases farmers should be aware of the signs and symptoms, and consider a post mortem on any animal that is found dead without obvious cause. Vaccination against blackleg can prevent incidences on pasture that is high risk.

Grass tetany, caused by low blood levels of magnesium is most prevalent with lush spring growth that has high levels of protein and potassium. This is another reason why regular soil testing to tailor fertiliser applications to plant needs is important. Excess potassium can exacerbate the incidence of grass