

# Soil and Nutrient Network



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Helping farmers improve soil and nutrient management

## Case study - Flowerburn Mains, Rosemarkie, Black Isle

Flowerburn is a mixed beef and arable farm owned and run by Graham and Genevieve Maciver. The farm extends to 107.38ha on class 3.1 and 3.2 land on the Black Isle, overlooking the Cromarty Firth and lying within the Inner Cromarty Firth Priority Catchment Area.

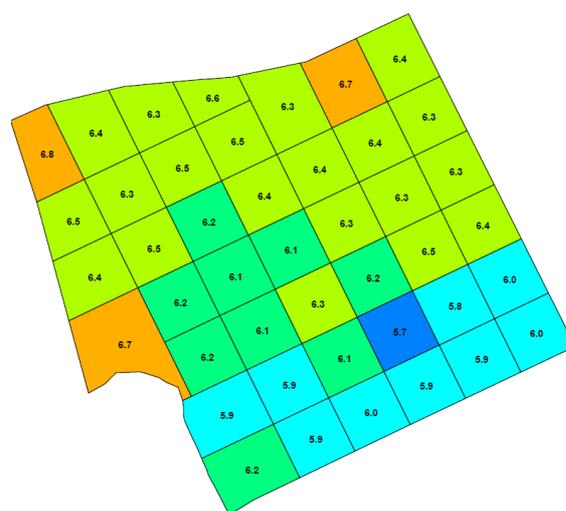
There is c48ha of spring barley yielding over 6 t/ha, following a traditional crop rotation. Most of the barley goes for malting, but c25t is kept for 76 Aberdeen Angus x Limousin suckler cows. Along with c10ha of silage (two cuts) and c4ha of kale the business is largely self sufficient in feed.

An additional 10ha of land is rented annually for grazing. There are several hectares of planted woodland and a coastal SSSI along steep cliffs running to the shore.

### Assessing Soils

The initial meetings discussed soil quality using the hands on Visual Evaluation of Soil Structure (VESS). The soils showed good structure although pockets of compaction were identified around tracks and gateways.

Soil analysis was undertaken across 6 fields showing some pH variability between fields, and some low P in the permanent grass field. and low copper, zinc and sulphur in some cropped fields.



GPS soil analysis from one of these fields highlighted local lime deficiencies along a ridge which could be addressed through targeted lime applications, thereby saving money compared to whole field applications.

For more information on the Soil and Nutrient Network see [www.farmingandwaterscotland.org](http://www.farmingandwaterscotland.org). For dates of SNN events, find us on Facebook or follow us on Twitter @FarmWaterScot.



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## Soil Organic Matter and Soil Organisms

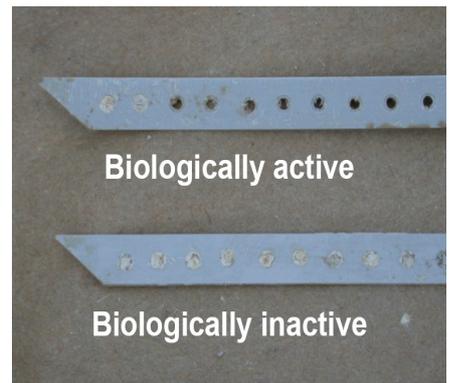
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Soil organic matter results obtained from routine soil analysis showed a range of 5.84% to 8.09% which is good for cropped land. A higher organic matter of 14.17% in the permanent grass field demonstrates the benefits of rooting, livestock grazing and associated inputs, and lack of cultivation.

Bait laminae sticks were set at 6 sites in 2 fields within the crop rotation for a period of 10 days during May when soils began to warm up. This was to investigate soil biological activity.

Generally, the soils showed good activity, with one site particularly active around a winter cattle feeding area.

This topic was of great interest to the farmers in permanent arable rotations; they left considering their options for incorporating straw and purchasing manure.



Bait laminae sticks which were used at Flowerburn Mains to give an indication of soil biological health

## The Impact of Farm Traffic & Tillage on Soils

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Surface applied loads, particularly in unfavourable conditions can result in soil compaction, which negatively affects agricultural productivity and also the wider environment by causing rutting, waterlogging and run off. These reduce soil biological activity.

Soil compaction was likely to be limiting crop and grass growth around gateways and tracks at Fowerburn Mains. This could be alleviated with a subsoiler.



## Nutrient Budgeting & Diffuse Pollution

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The farmyard manure from straw bedded courts was analysed and identified significant P & K that can reduce fertiliser applications.

Diffuse pollution risks from steading runoff into field drains was also discussed in relation to impacts on the nearby burn which runs into the Moray Firth SAC, SPA and Priority Catchment.

Runoff to field drains was avoided by covered courts and keeping dung heaps, poaching and tracking away from drains. Keeping an up-to-date RAMS (Risk Assessment for Manures and Slurries) map will help to remind where the sensitive areas are.

**PLANET** NUTRIENT MANAGEMENT PLANET is a free to download and use nutrient management software available for all farmers to use. It is available at [www.PLANET4Farmers.co.uk](http://www.PLANET4Farmers.co.uk) & has been subsidised by the Scottish Government.

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## Soil Type and Soil Compaction

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Structural damage of soil through compaction results in a reduction in yield, this has been shown to be between 5% and 15% for root and cereal crops, depending on the severity of compaction. However, research into two compaction types, animal trampling or tractor traffic, in grassland showed a reduction in silage yield of between 6% for trampled compaction and 14% for tractor compaction, over three years. Soil compaction is likely to be limiting crop and grass growth around gateways and tracks. This could be alleviated by use of a sub-soiler.

Visual assessment of your soil can help evaluate the extent of any damage and provide help with management decisions to correct the problems. Methods of returning structure to the soil needs to address the problem areas and may not show dramatic yield improvements in grassland. Controlled traffic, in grassland, could be one way of reducing yield loss from compaction by on average of 13%.

Biological activity within the soil is essential to providing sustainable yields, with earthworm numbers a good indication of soil health. Other simple methods can be considered to provide a measure of the quality of the soil and these can give an indication of how the soil can be improved.



Regular soil analysis will identify potential lack of nutrients that will reduce yield. This linked with an understanding of the crop off-takes allows the more effective application of fertilisers, with less loss of potential pollution.

## Weeds indicate soil type and soil condition

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- Spurreys, knotweeds, field pansies suggest acidic soil.



Photo: Sparganium, credit K Thiele, flickr cc - <https://bit.ly/2vU4x0j>



- Daisies, broad-leaved plantain, buttercups and annual meadow grass can indicate soil compaction, often on clayey or damp soil.



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## Legumes & Nitrogen Fixing

*Rhizobium* bacteria and legumes have a symbiotic relationship through which nodules are formed which convert atmospheric nitrogen to ammonia and amino acid, using energy supplied by the plant, hence fixed nitrogen can replace fertiliser. In fact nitrogen fertilisers negatively affect nodulation and mycorrhizae.

Grasses grown in mixtures with legumes can use up to 80% of the nitrogen fixed by legumes.

In grazed white clover pasture above ground nitrogen fixation rate is between 55 and 295 kg N year.

Mycorrhizal fungi form a symbiotic with many plants, and enhance nutrient uptake and protect plants from disease.

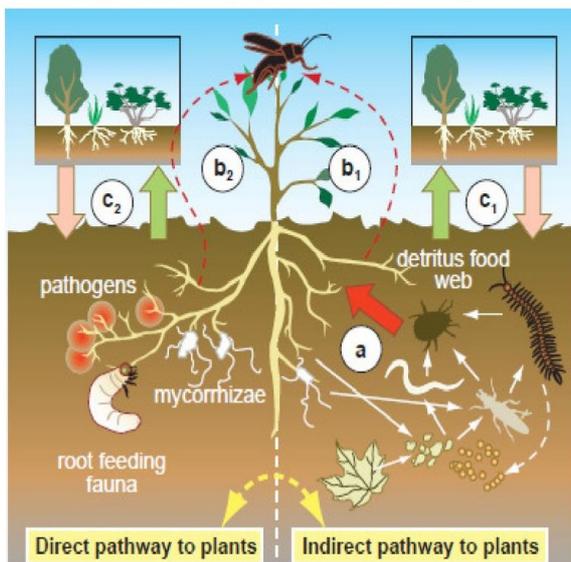
Legumes including clovers, peas, beans, lupins, will provide soil nitrogen for plant growth, and nectar and pollen for pollinators.



## Soil Fungi and Plant Nutrients

Mycorrhizal fungi form a symbiotic with many plants, and enhance nutrient uptake and protect plants from disease.

Linkages between plants and soil organisms



Wardle et al 2004. Science 304, 1624-1633

## Top tips for all farms

- A healthy soil can really improve farm profits.
- **Good soil structure is important** to facilitate air flow which enhances size and distribution of nodules on legumes which provides nitrogen.
- **Maintaining optimal soil pH and aeration** boosts grass and reduces competition from weeds.
- **By including legumes in grass mixes, cover crops or green manures**, you can add nitrogen and provide essential food for pollinators.
- **Look at soil structure** - If a crop looks to be poorly performing, look at soil structure using the VESS guide and count the worms you find.
- **Minimise compaction** by using the smallest tractor, use the correct tyre size and

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