

Soil and Nutrient Network



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Helping farmers improve soil and nutrient management

Case study - Bielgrange, East Lothian

Father and son Angus and Niall Jeffrey farm 288 ha (711 acres) arable and 246 ha (608 acres) of grassland over two farming units in East Lothian. Bielgrange lies between the village of East Linton and Stenton with Weatherly on the edge of the Lammermuir Hills.

The crop rotation includes winter barley, winter oilseed rape and winter wheat which can often go beyond a third wheat. Crop establishment for oilseed rape and 1st wheat's is by minimum tillage with conventional ploughing for winter barley and successive wheat crops.

Cattle muck is applied in the late summer to winter barley stubbles ahead of oilseed rape establishment when the ground is at its driest to try and limit compaction. Pig slurry from a neighbouring farm is spread by umbilical on adjacent cereal crops and by tanker on grazed permanent pasture in the spring.

The arable soils are mostly imperfectly drained, non-calcareous brown forest soils of a clay loam texture from the Biel series (land capability index 3.1). The upland Weatherly unit features free-draining sandy loam from the Innerwick series on the inbye and peaty and humus soils from the Lauder series on the hill (land capability index 4.2 to 5.2). Weatherly is grazed by 240 spring calving Aberdeen Angus cross cows which are wintered at Bielgrange on straw based diets.

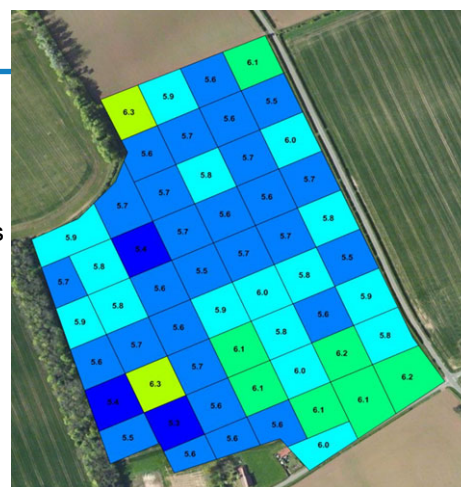
GPS Soil Sampling

Conventional W pattern sampling is routinely undertaken, but as part of the project GPS sampling was tried over two fields.

North Grangemuir (right) was sampled by W-pattern in 2017 with a 6.1 pH result. Niall intended to apply lime post-harvest in 2018, however the field was GPS grid sampling at ¼ hectare grids. The GPS testing revealed a pH range from 5.3 to 6.1 and a field average pH 5.8.

1.74 ha of the field was found to have a pH under 5.5. Below this pH on a mineral soil a 30% yield loss can be expected in wheat. Based on 10t/ha crop @ £165/t this field has effectively underperformed by £860 a year simply due to the soil pH.

The reason yield is limited below 5.5 pH is due to aluminium coming into solution in the soil and inhibiting root growth; effectively limiting the plants ability to take up nutrients.



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



Lime: Key Facts

- Scottish soils are naturally acidic and require lime to keep them at optimum pH and performing to fulfil their potential.
- Lime is not a nutrient taken up by the plant.
- Liming materials should be judged on their % neutralising value, particle size of product and cost.
- Apply no more than 7.5t/ha in a single application.
- Maintaining an optimum pH improves plant nutrient uptake and soil microbial activity.

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Why does pH vary?

Heavy texture soils drop in pH more slowly than lighter soils, so a variable soil type can be a reason for pH variability within a field. The merging of fields which were historically managed differently also contributes to field variation in the new larger field. Historical lime spreading causes variation due to variable spread patterns of machine, spreading accuracy of operator and variability of liming product.

Once lime is applied it can take 6 to 18 months for the full neutralising reaction to take place. This is because the finer the particles of liming product act faster than the coarser particles.

It is recommended that light sandy soils are tested every 3 years and heavier soils every 5 years.

The benefits of GPS sampling are numerous but often producers are put off by the upfront cost. Most producers agree that applying lime is good practice and a worthwhile investment, in simple terms **GPS applications are targeted and put lime in the right location where it will give the most benefit.**

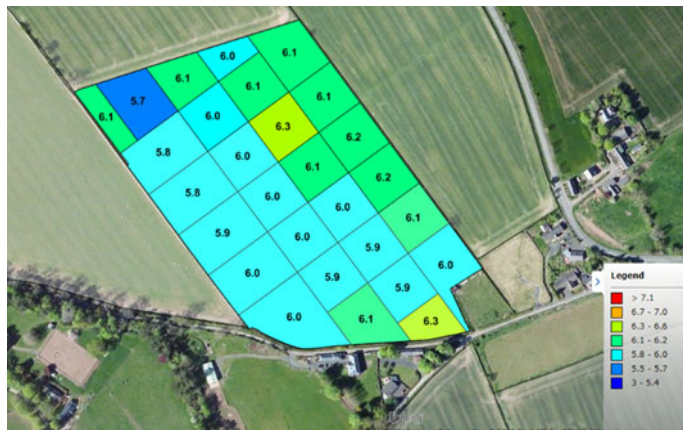
Does grid size matter?

When sampling by W-pattern the rule of thumb is 5 cores per ha. When grid sampling, 12 cores are taken in each grid. Grid sampling creates a true and repeatable picture of soil pH. Sampling at ¼ ha grids gives the best picture of field pH variability and allows for quicker and more accurate removal of variability.

The point is made on the following maps from a previous Soil & Nutrient Network Farm where grid sampling of a field was done at both 1 ha and ¼ ha grids. The ¼ ha grids reveals more pH variation and will avoid the over and under application of lime that would have occurred when using 1ha grids.



pH Map using 1 ha Grids



pH Map using ¼ ha Grids

What is good soil health?

Interest in soil health is growing at both farmer and government level. The UK government's recent 25-year environment plan indicated that future agricultural policy will focus on soil health and structure, with targets on soil health likely to be set in the next Agricultural Bill.

Good soil health is where the biological, physical and chemical interactions in soil are in balance.

Biological - At a simple level a healthy biologically active soil is one full of life with lots of worms and good microbial activity. This helps to breakdown crop residues, recycle nutrients and make them available for plant uptake. Active and diverse soil life also helps to keep pathogens and pests in check.

Physical - A physically healthy soil has 25% airspace which allows filtration of water, good rooting and gaseous exchange of nutrients. Rooting is compromised when the soil air is squeezed out by field traffic or when compacted layers or pans are created by cultivations.

Chemical – farmers are already actively managing soil pH and major plant nutrients. Further useful analysis would be: measure soil organic matter which benefits both the biological and physical properties; test the soil microbial activity. Microbial activity can be assessed using the potentially mineralisable nitrogen test. This is a measure of the capacity of the soil microbial community to convert nitrogen tied up in organic residues into plant available ammonium.



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How to benchmark your soil health

1. Complete soil analyses of pH and key nutrients, organic matter (loss on ignition) and potentially mineralisable nitrogen (PMN)
2. Across several field digs:
 - » Complete a visual evaluation of soil structure using the VESS template
 - » Check earthworm abundance by counting the number of worms from a 20x20cm block of soil

Ideally these checks should be taken at the same time of year (spring or autumn) and at the same point in a crop rotation. Avoid sampling during the growing season when nutrients are being applied to the crops. Note, the worm count can be adversely affected when soils are dry or during periods of low soil temperature.



Soil health at Bielgrange

A soil health check was completed in the Stackyard field during the first on-farm meeting with a further two fields added several weeks later.

Table 1: Soil health at Bielgrange

	pH	P	K	Mg	S	VESS	Worms	Organic Matter	PMN mg/kg
Stackyard	6.2	M+	M+	H	L	1.5	8	5.83	32.8
N Grangemuir	5.8	M-	M+	H	L	2.5	<3	6.03	22.7
Crumstanes	6.3	H	M+	H	H	2.5	15	5.67	29.7

The major nutrients are at target levels or above. Sulphur which affect the plants ability to efficiently utilise available nitrogen is low in some fields and indicates a higher risk of plant deficiency. Tissue analysis at stem extension is a more reliable way to confirm plant deficiency.

To measure physical and biological health, 3 digs were completed across each of the fields with an average score allocated.

At the meeting Niall identified Crumstanes as one of his most consistently high yield field and North Grangemuir as inconsistent. North Grangemuir nutrient status is lower, and the GPS sampling shows there is a wide range in pH. It is also interesting to see the field digs revealed very few worm and a lower PMN measure despite a slightly higher level of organic matter. Now that a benchmark has been established it will be interesting to see how things change over the next 5 years.

Valuing Your Soils



Find out more about soil health and ways that you can improve it from the 'Valuing Your Soils - Practical guidance for Scottish farmers' booklet. Packed full of tips and ideas to help you protect and improve farm soils which could also make your farm business more profitable.

The booklet includes case studies with real evidence of good practice and advice for current issues facing Scotland's farming community; simple guidance for taking action and valuing your farm soils & ideas on how you can increase the efficiency, productivity and sustainability of your farm.

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