Soil pH and Lime Requirement

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Nutrient Availability

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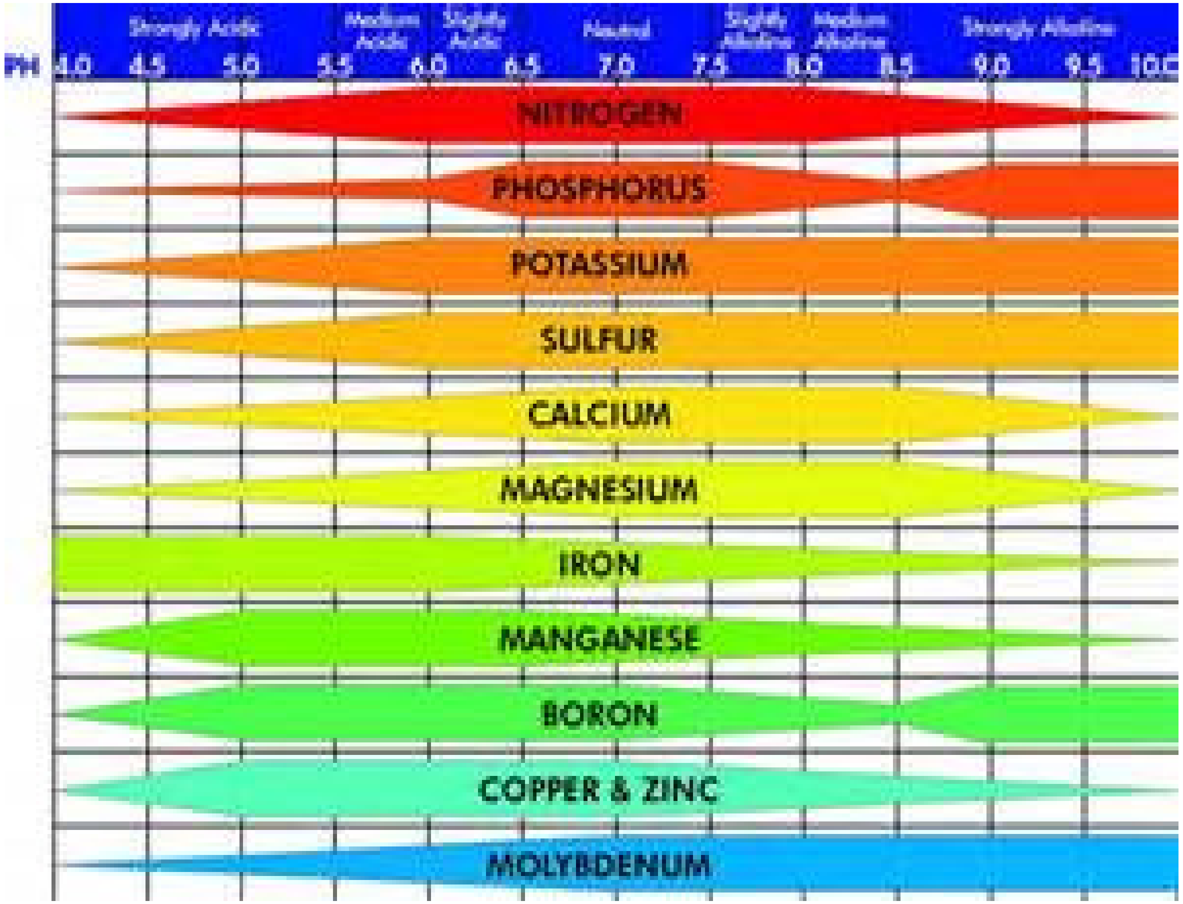
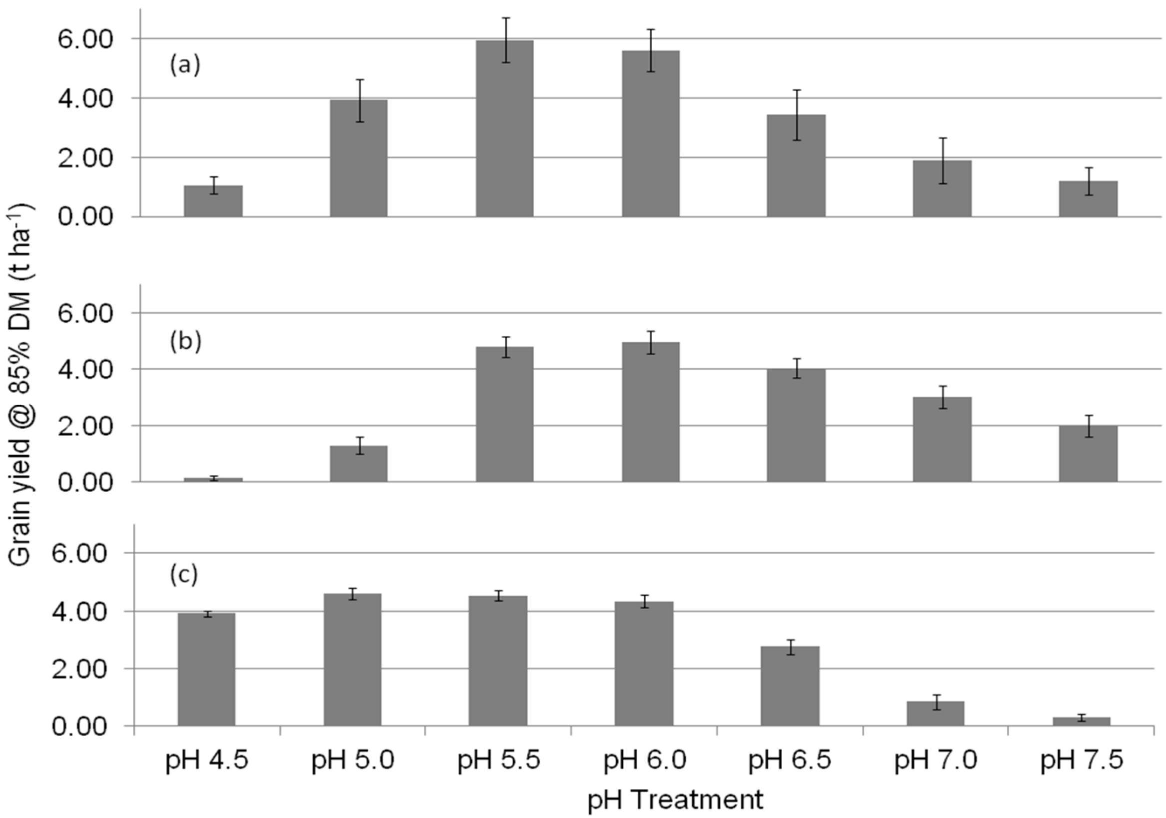


Mean cereal yield at each pH over period 1969-2008 (Woodlands, Craibstone). (a) winter wheat; (b) spring barley and (c) spring oats



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Crops differ in their sensitivity to soil acidity

increasing	Potatoes, ryegrass
sensitivity to	Oats, wheat, oilseed rape, clover
soil acidity	Barley, beans, peas, sugar beet

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Soil pH and Liming

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On mineral soils containing up to about 12% organic matter, soil pH values have the following significance for crops.

pH range	Comments
Below 5.0	Possibility of failure of all crops
5.0 - 5.4	Possibility of failure of barley, oilseed rape, peas and beans
5.5 - 5.9	Barley, wheat, swedes, turnips, oilseed rape, beans, peas, lucerne and red clover may suffer from acidity. This is more likely to be evident as low pH patches within a field.

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6.0 - 6.5	Suitable for most arable crops, eg. potatoes, barley, wheat, oilseed rape, swedes, turnips, fodder beet, peas and beans. At higher end of the range, trace element problems in all crops and common scab in potatoes may occur.
Above 6.5	Trace element deficiencies are most likely to occur on most soils. However, the incidence of whiptail in cauliflower and clubroot in continuous horticultural brassicas is reduced.

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Soil pH and Liming

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- Understanding your soil test – pH
  - pH: is a measure of the concentration of H^+ in your soil using a negative *logarithmic scale*.

This means that a soil with a pH of 5.7 is *significantly* more acidic than one at 5.8

20% of yield variability due to soil pH status

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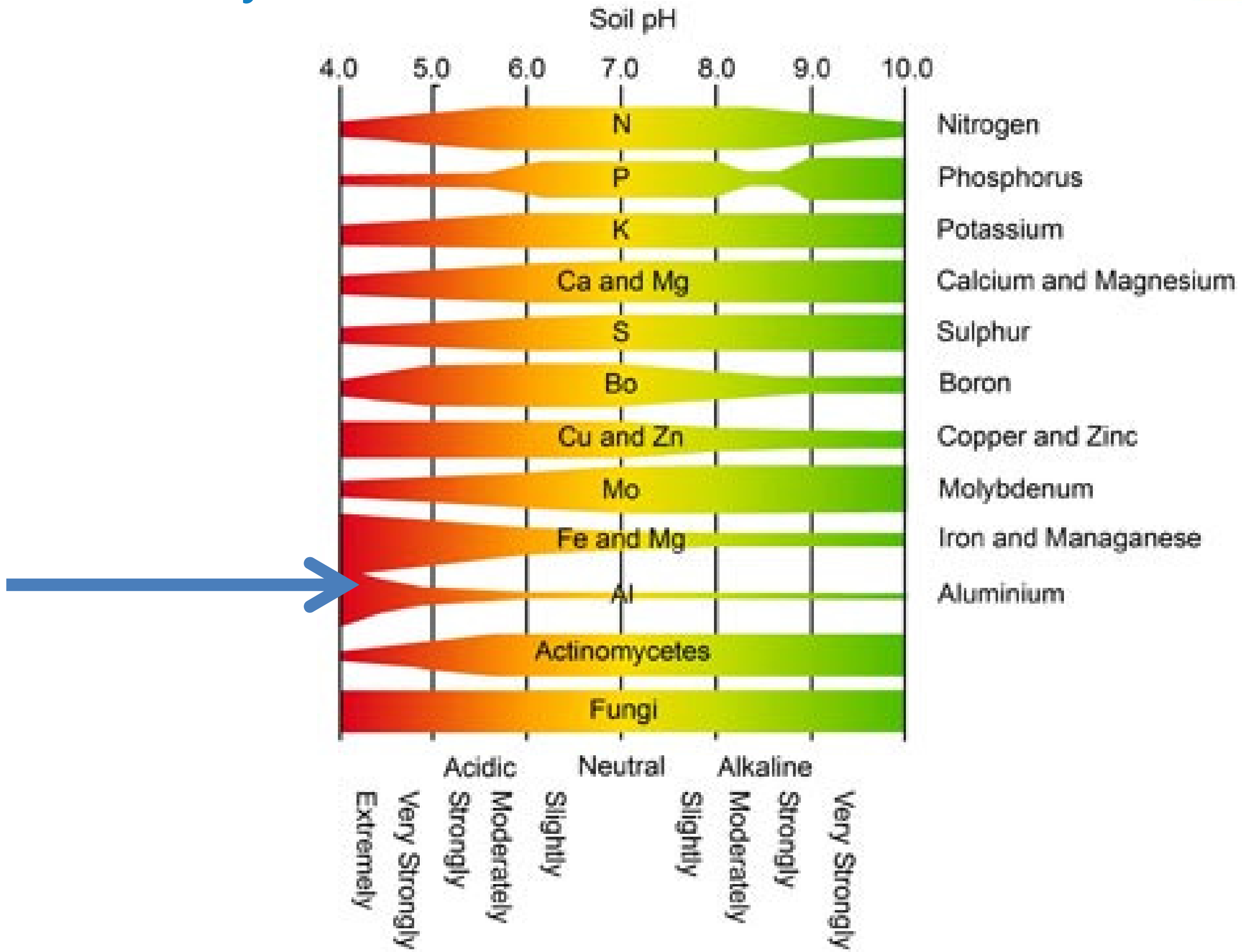
Why do we apply lime?

At soil pH values below 5.6 in mineral soils in Scotland

soluble aluminium inhibits cereal root growth and reduces yield.

Soil pH: Impact on nutrient availability and form



Aluminium Toxicity

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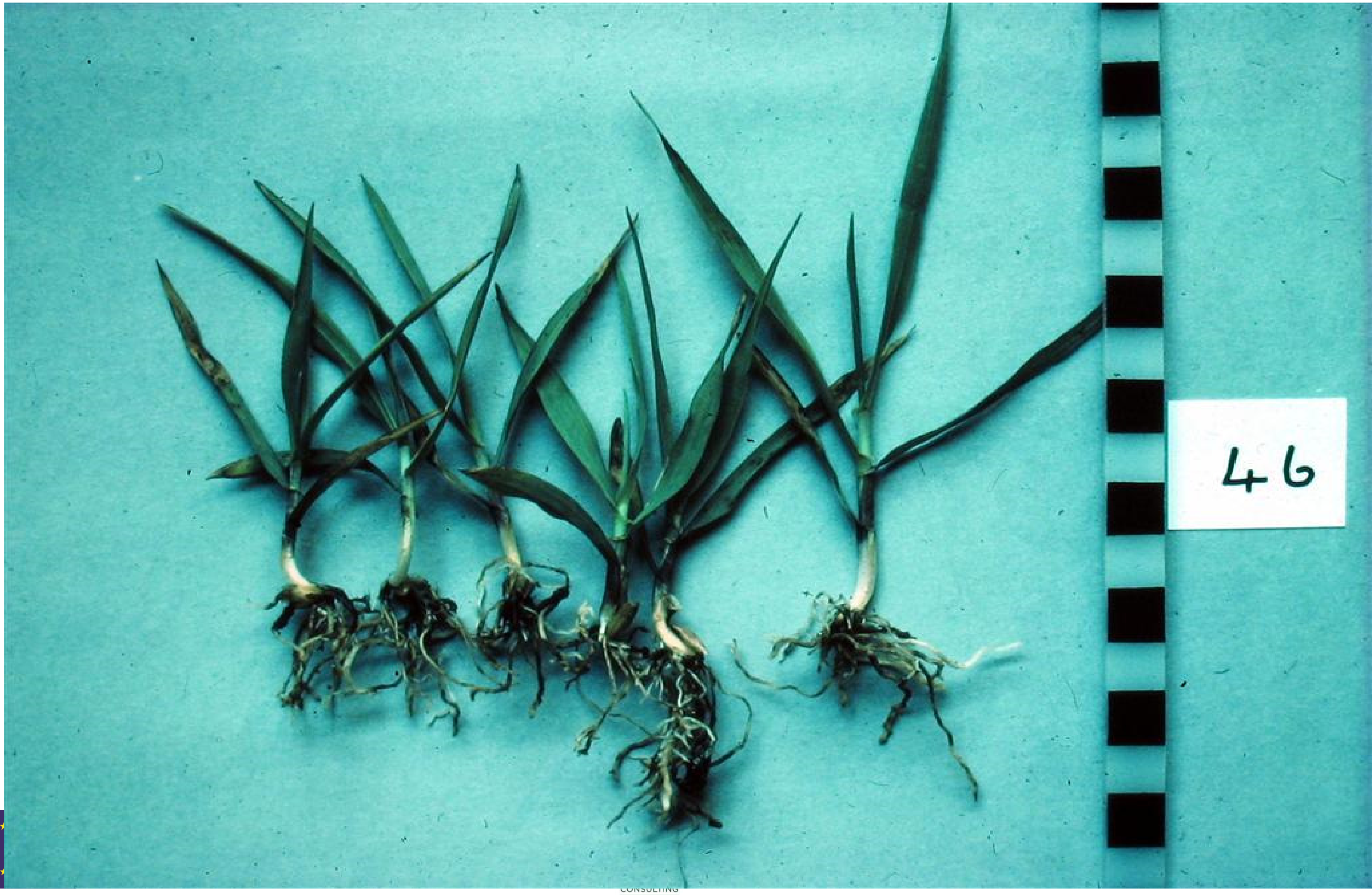

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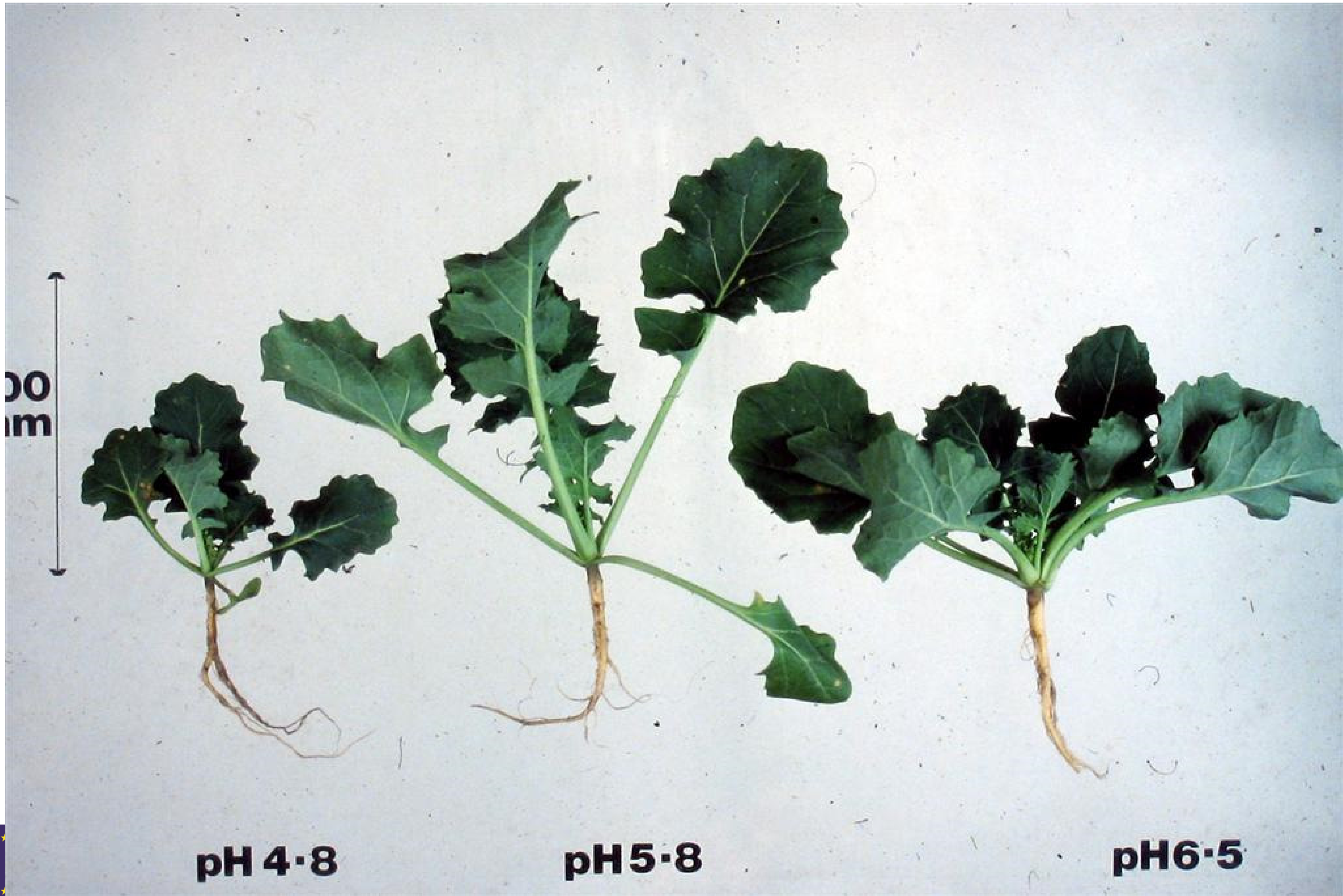

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Soil pH and Liming

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- Soil pH falls gradually due to leaching of lime, off-take in crops and livestock and acidification from fertilisers such as ammonium nitrate. The application of lime corrects soil pH.
- Continuous process

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Soil type descriptions and lime recommendations

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- Sands – *low buffering capacity and very rapid pH changes*
- Sandy loams - *low buffering capacity and rapid pH changes*
- Other mineral soils – *High buffering capacity and slow pH Changes*
- Humose and Peaty soils – *Very high buffering capacity very slow pH changes – These have lower targets (pH 5.3 – 5.5) in most advisory systems*

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Technical Note TN656

SRUC

November 2013 • All

Soils information, texture and liming recommendations.

SUMMARY

- Web based access to information on your soils on your farm is described.
- Soil texture classes of mineral soils are described and identified by hand texturing.
- Liming recommendations for different soils and managements are tabulated.

1. Introduction

Scotland's soils have been comprehensively surveyed, classified, and studied over the past 75 years. Understanding and using this information at the farm level has up till now been difficult due to its complexity and the accessibility of information. The development of web based tools has changed this and The James Hutton Institute, who hold the National Soils Database for Scotland, have created the SIFSS (Soil Indicators for Scottish Soils) website which allows you to access information on your soils. SIFSS is also available as a free iPhone app for you to find out what soil type is in your area, discover the differences in soil characteristics between cultivated and uncultivated soils, and also to examine a range of key indicators of soil quality.

In this technical note the influence of soil texture on target soil pH values and liming requirements of crops and grass is described. Regular soil testing is required every 4 - 5 years in order to monitor success in maintaining targeted levels of lime. This note can be used along with PLANET Scotland, a software tool designed for routine use by Scottish farmers and advisers to plan and manage lime and nutrient use on individual fields.

There is also on-going work that will make the information relevant to how we manage our soils on a daily basis. Further technical notes are planned linking trace element status with soil parent material, texture and pedological drainage status; and rates of phosphate fertiliser to build up and run down soil P status with a different set of soil properties.

Lime recommendations for arable & rotational grass (t/ha with NV 50% CaO)

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Soil pH	Sand	Sandy loam / shallow	Other mineral soils	Humose	Peaty
6.2	0	0	2	0	0
6.1	0	2	3	0	0
6.0	2	3	4	0	0
5.9	2	4	5	2	0
5.8	3	4	5	3	0
5.7	4	5	6	4	0
5.6	4	6	7	5	2

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Liming Material	Approx. NV (Neutralising Value)		
	% CaO		% CaO
Calcium carbonate	56	hydrated lime	70
Ground magnesian limestone	56	burnt lime	90
Ground limestone	48	paper waste	10
Sugar beet waste lime	20	shell sand	30

Neutralising value indicates different 'strengths' of liming materials

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Can not forecast where soil pH is likely to change within fields

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- Therefore need to use a GRID to effectively map changes in soil pH.

- Grid area needs to be on a sufficiently small geographic scale to capture the spatial variability.

Why grid pH sampling of defined areas?

- Soil pH mainly varies within fields for 3 reasons:
  - Old field boundaries.
  - Soil Texture.
  - Lime application. Most spreaders spread to 10/12 meters and are notoriously variable (partly due to lime itself not flowing easily). Under or over application tends to persist in the soil for decades.

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Why grid pH sampling of defined areas?

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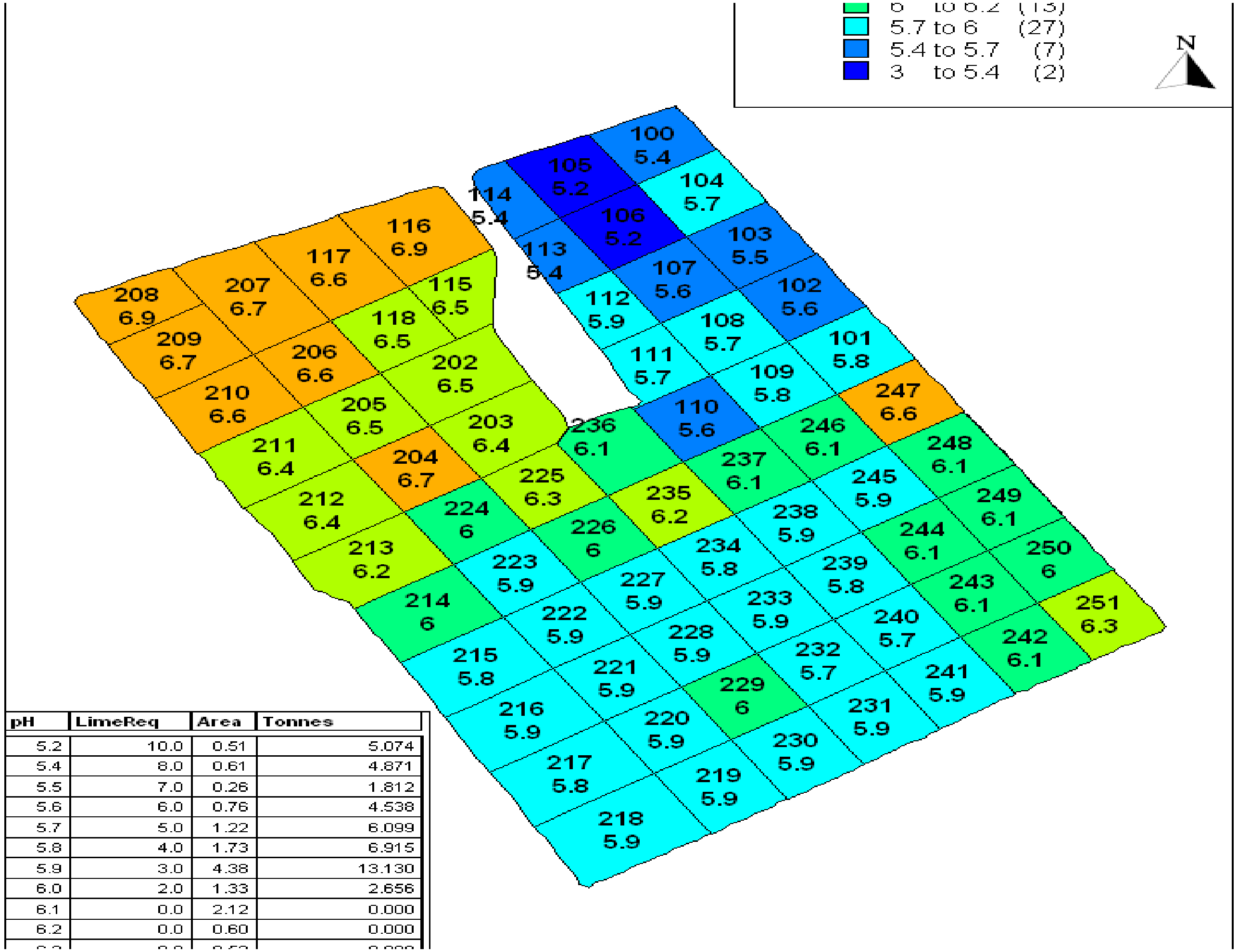
- Application mistakes tend to be accumulative and long lasting. **Can not forecast** where they occur. Some examples are:
  - Lime tipped in field gateways.
  - Spreaders chocking/running out of lime.
  - Double application (usually around headlands) to get rid of the last 5 tonnes in the spreader at the end of the job.
  - Calibration errors – 1^{st} side of field done at 1 setting, 2^{nd} side done at another.
  - Spreader sticks and all the lime is dumped out – or wet holes don't get any.

Map of grid areas

- Notice pH 6.7 bounded by pH 6.0 & 6.5. Computer-generated map would not predict 6.7.



pH	LimeReq	Area	Tonnes
5.2	10.0	0.51	5.074
5.4	8.0	0.61	4.871
5.5	7.0	0.26	1.812
5.6	6.0	0.76	4.538
5.7	5.0	1.22	6.099
5.8	4.0	1.73	6.915
5.9	3.0	4.38	13.130
6.0	2.0	1.33	2.656
6.1	0.0	2.12	0.000
6.2	0.0	0.60	0.000

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Computer generated interpolation maps

- Computer generated interpolation is notoriously difficult and unreliable when you have a small number of samples per ha (yield maps can have 100's of samples per ha so interpolation is much more reliable).

- It also assumes that the soil pH changes evenly and predictably across the field i.e. if point A is 6.0 and point B is 6.6 then half way between A and B must be 6.3.

- This is not the case in reality as soil pH uses a logarithmic scale and can change abruptly in the field in an unpredictable manner.

Soil sampling protocol

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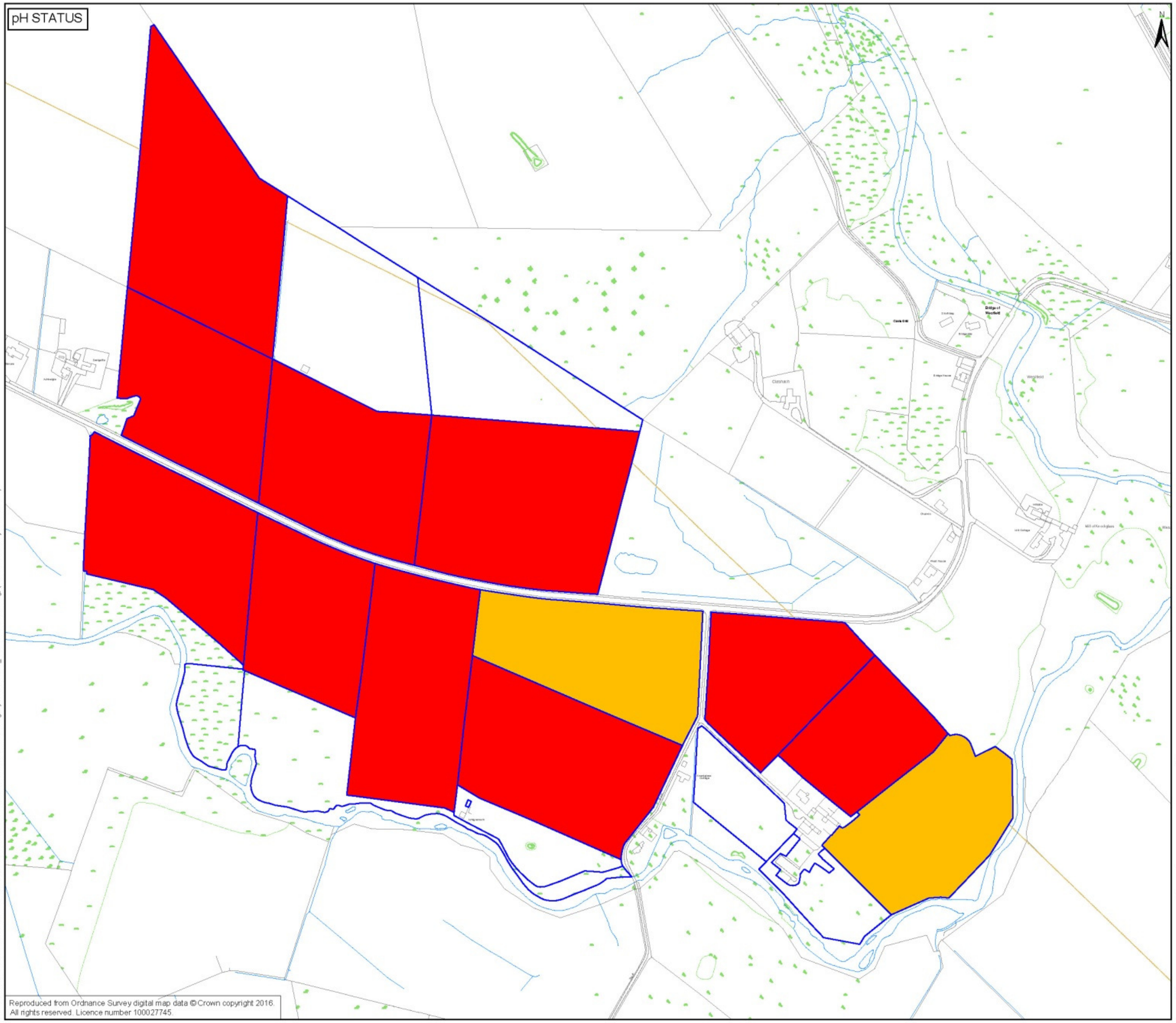
- Benefit of grid areas is that you are spreading lime on the ACTUAL pH result from the lab – not a computer generated, interpolated map of what soil pH might be.
- Try and take around 12 to 16 sub samples from a grid in a circle about 15m from the grid centre so that getting at least 1 sub-sample from every pass of the lime spreader when it spread lime last time the field was limed – no matter which way the spreader passed through the grid.
- Always align the grids with the side of the field the lime is going to be spread from and that way most of the time the spreader fits into the grids – i.e. in a 50m grid its 4 passes of a 12m spreader, 5 passes of a 10m spreader. This ensures lime is spread on the AVERAGE pH value of the grid.



LEGEND

pH (mg/l)

- Very Low < 5.7
- Low 5.7 - 5.8
- Moderate (-) 5.9 - 6.0 (Target for Grassland)
- Moderate (+) 6.1 - 6.2 (Target for Arable Land)
- High 6.2 < 8.4
- Very High > 8.4

pH Status

KNOCKGLASS FARM

DRAWING NO.	SCALE	DATE
1030204-SK-6	1:5000@A3	MAR 2016

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