Making the best of GPS

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Jonathan Black
Agricultural Consultant

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Using GPS +/- variable rate applications to correct soil nutritional problems.

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VRA seed

VRA fertiliser

VRA Lime

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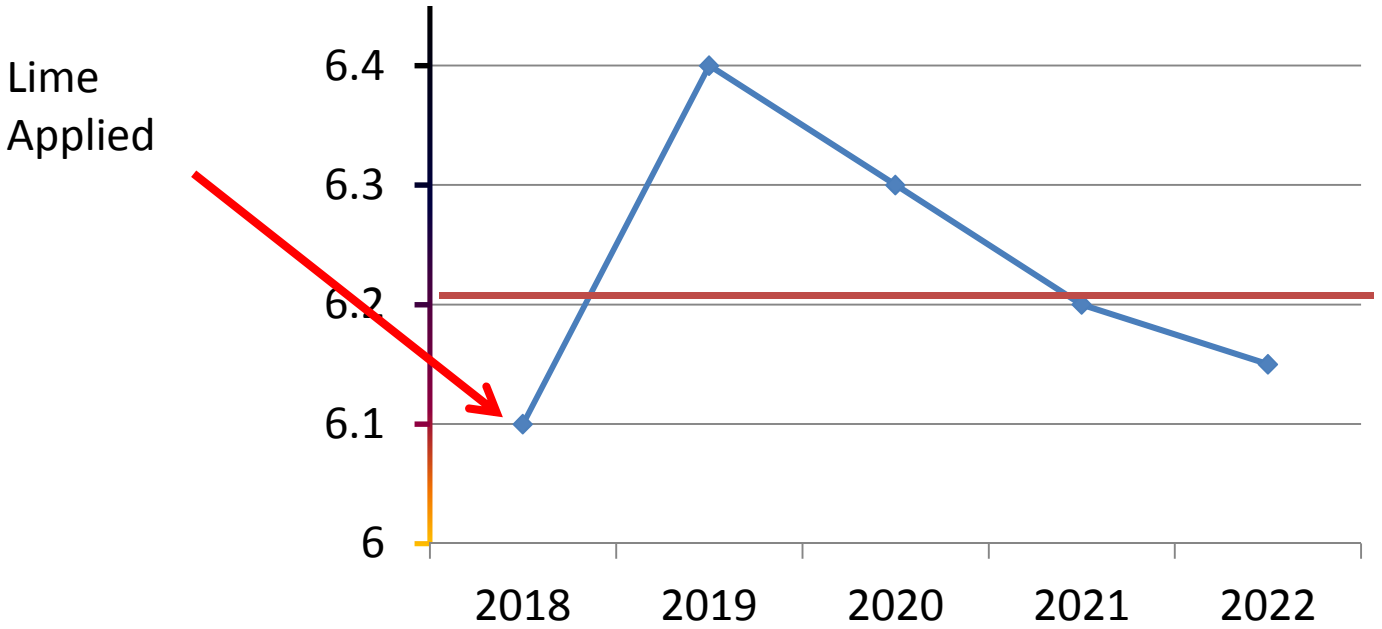
What are we trying to do?

- Grow a crop in a variable environment (soil, weather & pH) to achieve optimum yields and consistent crop quality
- Keep the field within 0.2 of 6.2 target



Soil pH mainly varies within fields for 4 reasons

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1. Soil type
2. Lime tipped in field gateways
3. Spreaders choking/running out of lime/double application
4. Calibration errors

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Variation within an area and within a field

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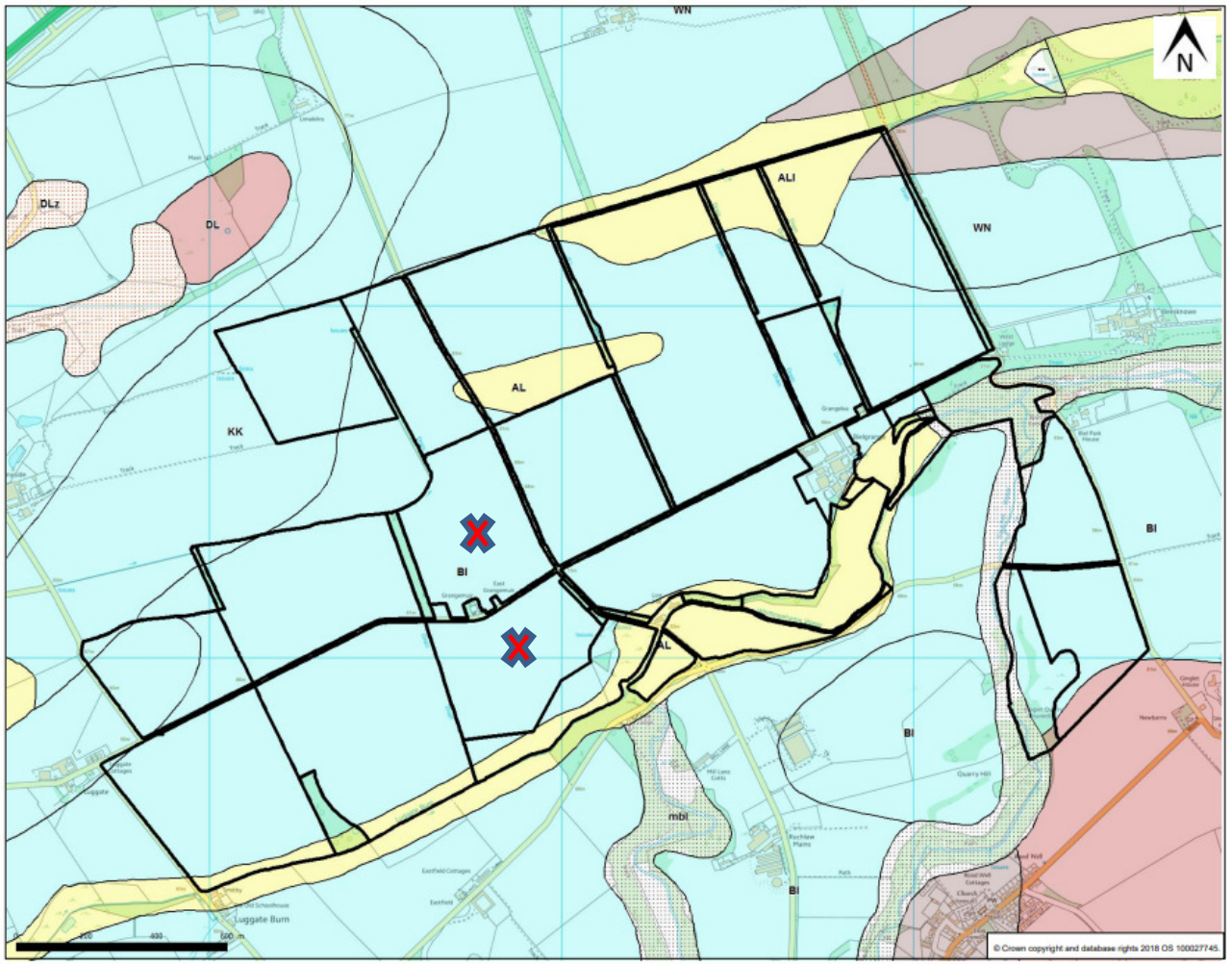

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North Grangemuir Ave pH 5.8

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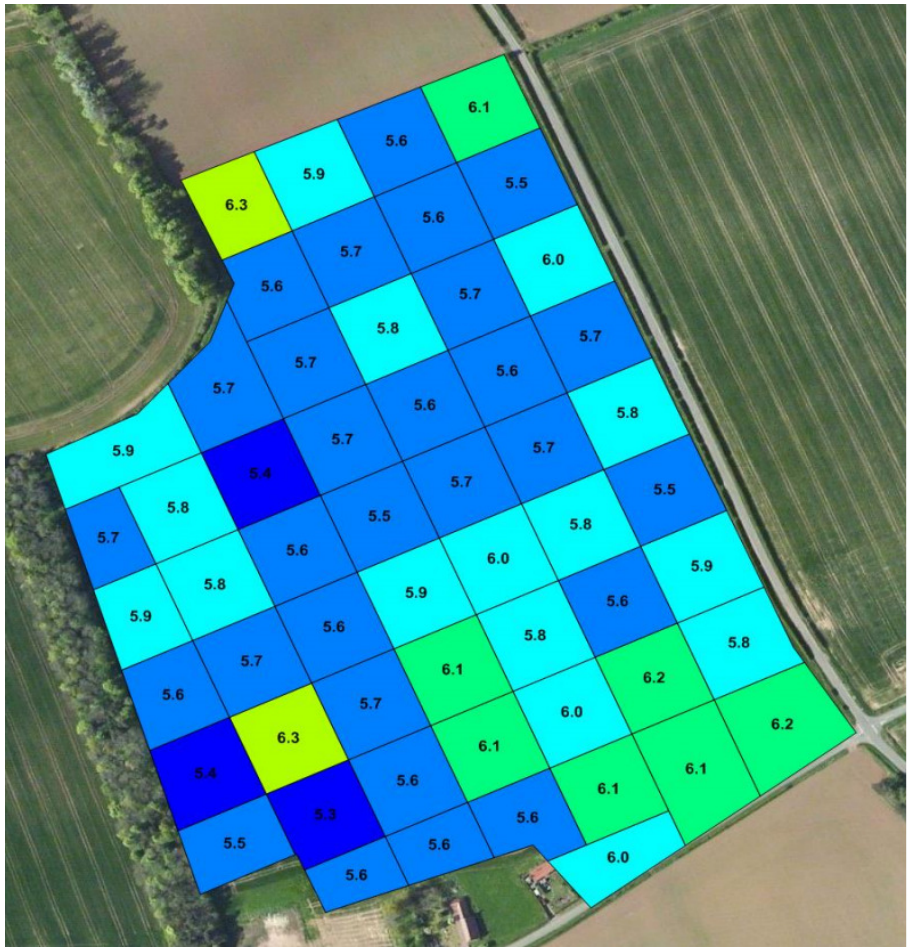

pH	Lime Req	Area (ha)	Tonnes
5.3	8181	0.249	2.037
5.4	7272	0.506	3.68
5.5	6363	0.986	6.274
5.6	5454	2.999	16.359
5.7	4545	2.723	12.374
5.8	3636	1.774	6.451
5.9	2727	1.267	3.455
6.0	1818	0.958	1.742
6.1	909	1.335	1.213
6.2	0	0.588	0
6.3	0	0.477	0
Av pH	**No. Samples**	**Total**	**Total**
5.8	56	13.862	53.6

6.1 Conventional W Pattern

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“GPS costs more !”

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- Under pH 5.5 = 1.74 ha
  - Up to 30% loss in winter wheat
  - 10t/ha crop down to 7 t/ha
  - 3t/ha @ £165/t
  - ~£860 less output from the field in year
  - Sampling ~£390 for a yield increase of 5t

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South Grangemuir Ave pH 6.3

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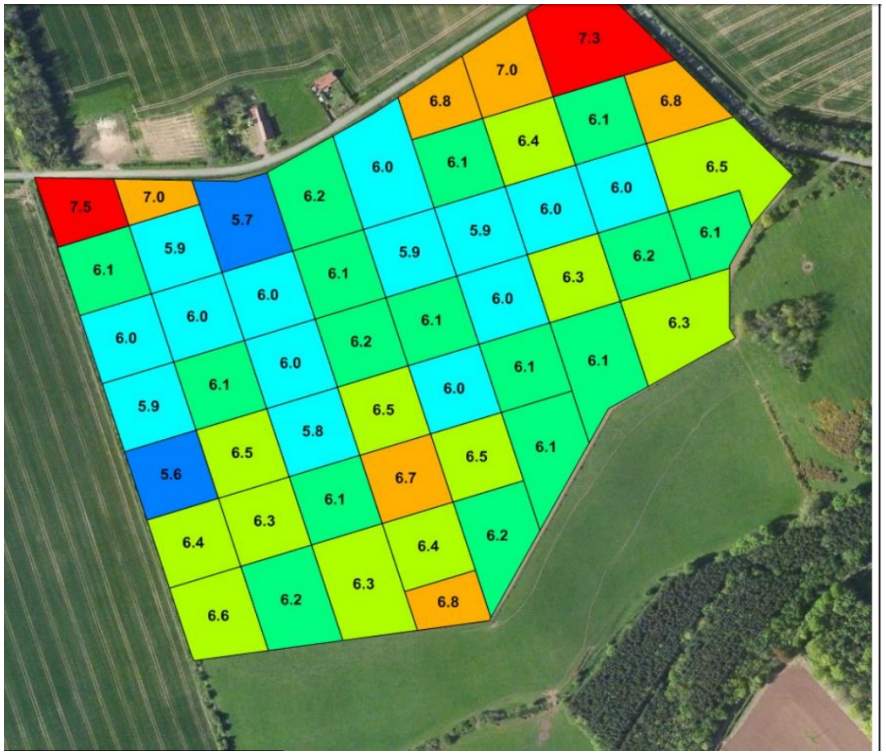

pH	Lime Req	Area (ha)	Tonnes
5.6	5454	0.253	1.38
5.7	4545	0.302	1.373
5.8	3636	0.25	0.909
5.9	2727	1.003	2.736
6.0	1818	2.374	4.319
6.1	909	2.891	2.627
6.2	0	1.448	0
6.3	0	1.254	0
6.4	0	0.753	0
6.5	0	1.173	0
6.6	0	0.291	0
6.7	0	0.25	0
6.8	0	0.6	0
7.0	0	0.395	0
7.3	0	0.468	0
7.5	0	0.217	0
Av pH	**No. Samples**	**Total**	**Total**
6.3	52	13.922	13.3

6.4 Conventional W

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Does pH limit yield?

- Even field up with GPS and blanket apply,
- Up to 50% loss in Spring barley

Notice thick, stubby roots

Why is pH so important?

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- At soil pH values below 5.6 in mineral soils in Scotland soluble aluminium inhibits cereal root growth and reduces yield.

- Plant produces stubby roots instead of long fibrous roots – limits nutrient uptake

- At best limits yield, at worst crop is a right off

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pH effect on yield

Values of 5.5 and lower;

- Up to 20% in grass
- 30% in winter wheat
- 50% in spring barley

“even with adequate PK fertiliser!”

Limits the availability of other nutrients

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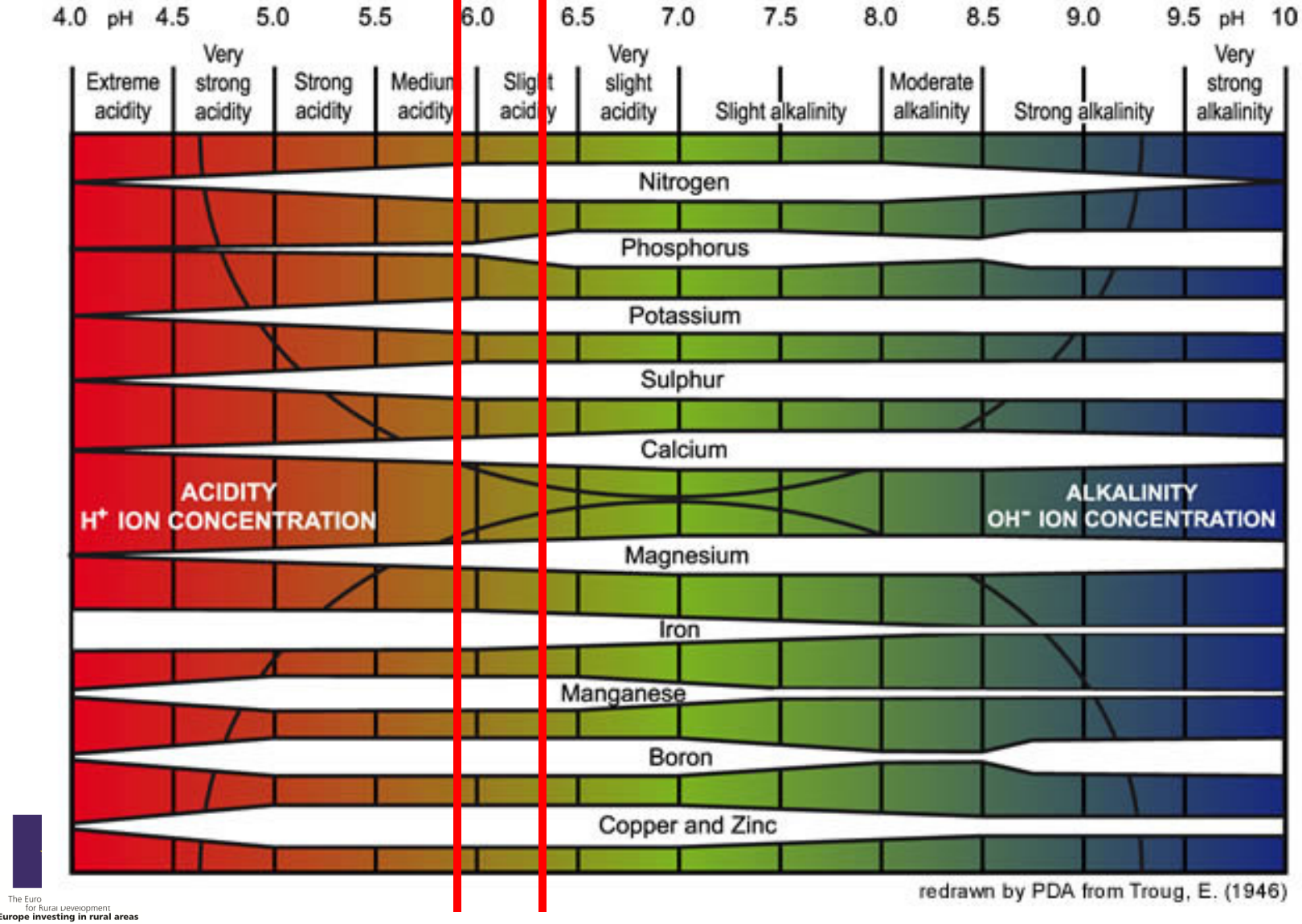

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Soil pH mainly varies within fields for 3 reasons

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- Old field boundaries
  - Due to different cropping/liming/field histories

- Soil Texture
  - Light soils tend to drop quicker and need less lime to increase pH
  - Heavier soils tend to drop slower but need more lime to increase pH (TN656)

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Technical Note TN656

SRUC

November 2013 • All

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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.

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Cannot forecast where soil pH is likely to change

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- But we can analyse using GPS to find this out

- There are two ways this can be mapped
  - Computer generated interpolation maps
  - Grid pattern

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The sampling is Important

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Computer generated interpolation maps

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- 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.

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Computer generated interpolation maps

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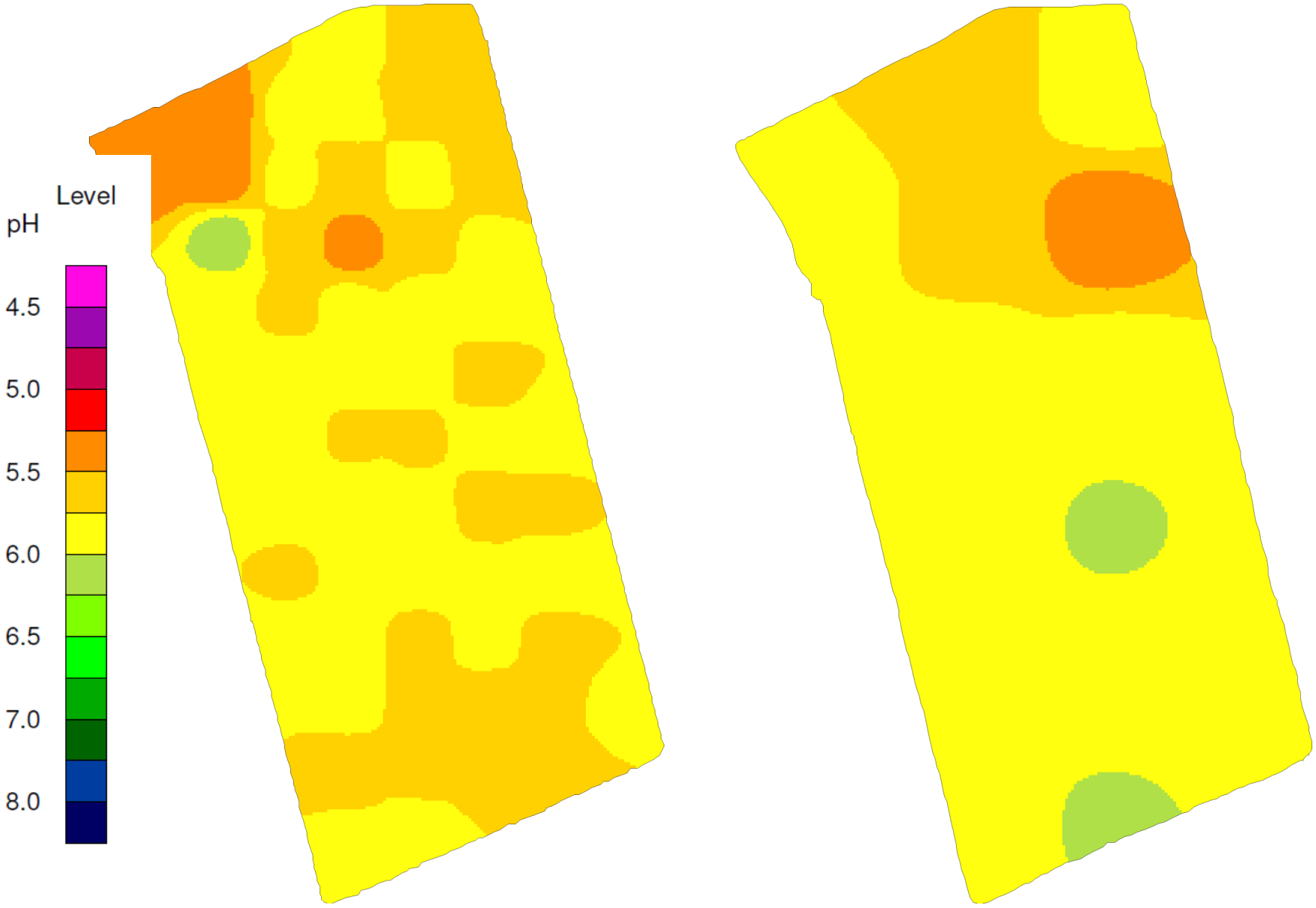
- This is not the case in reality as soil pH can change abruptly in the field in an unpredictable manner.

Spot the difference: 4 /ha and 1 /ha



1 ha Grids = 12 cores per ha

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7.59 ha x 12 = approx 91 cores per field

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¼ ha Grids = 48 cores per ha

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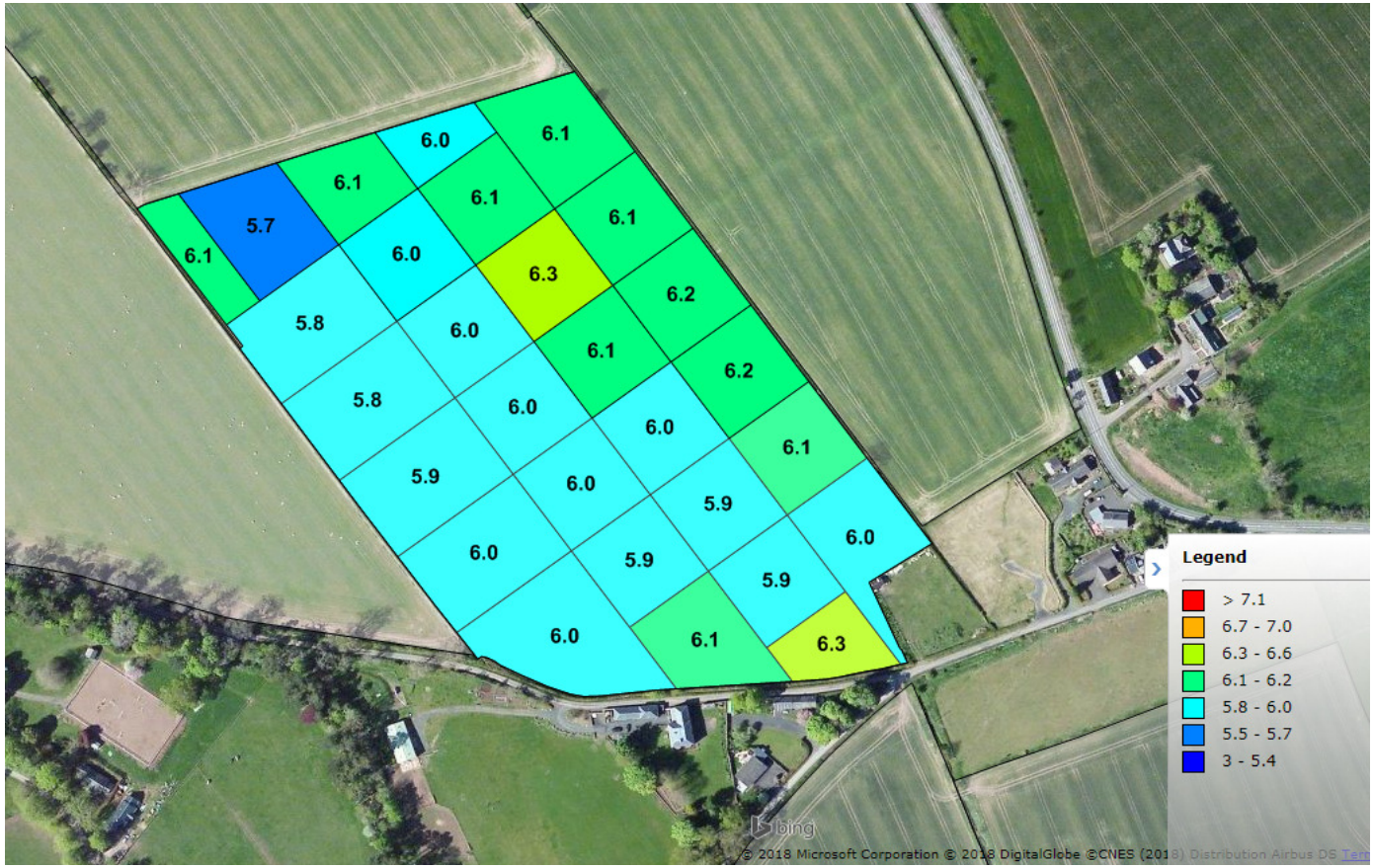
7.59 ha x 48 cores = approx 364 cores per field



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W pattern pH 6.0

1 ha grid pH 5.9 to 6.2

¼ ha grid pH 5.7 to 6.3

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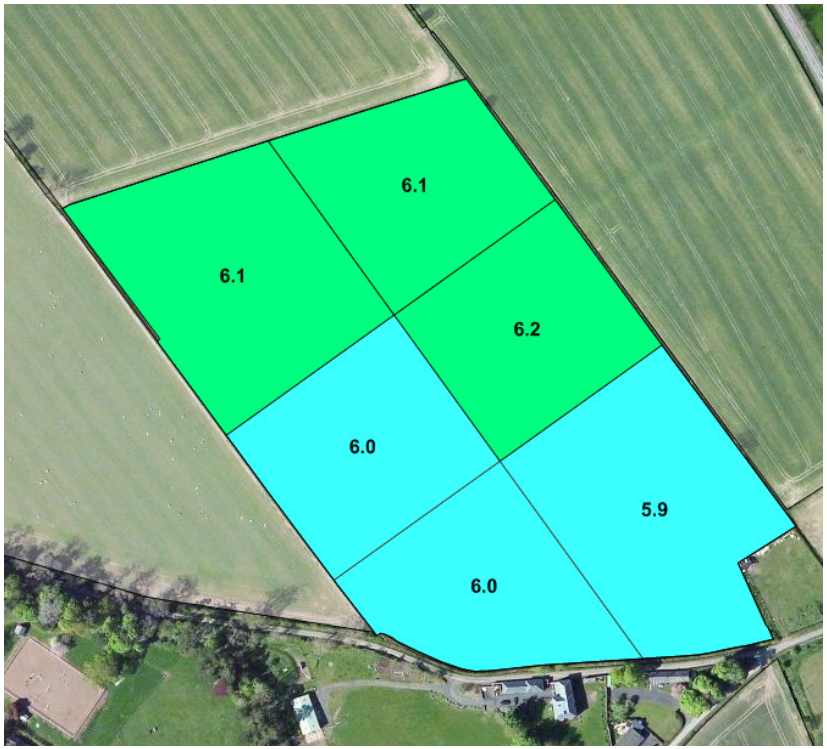

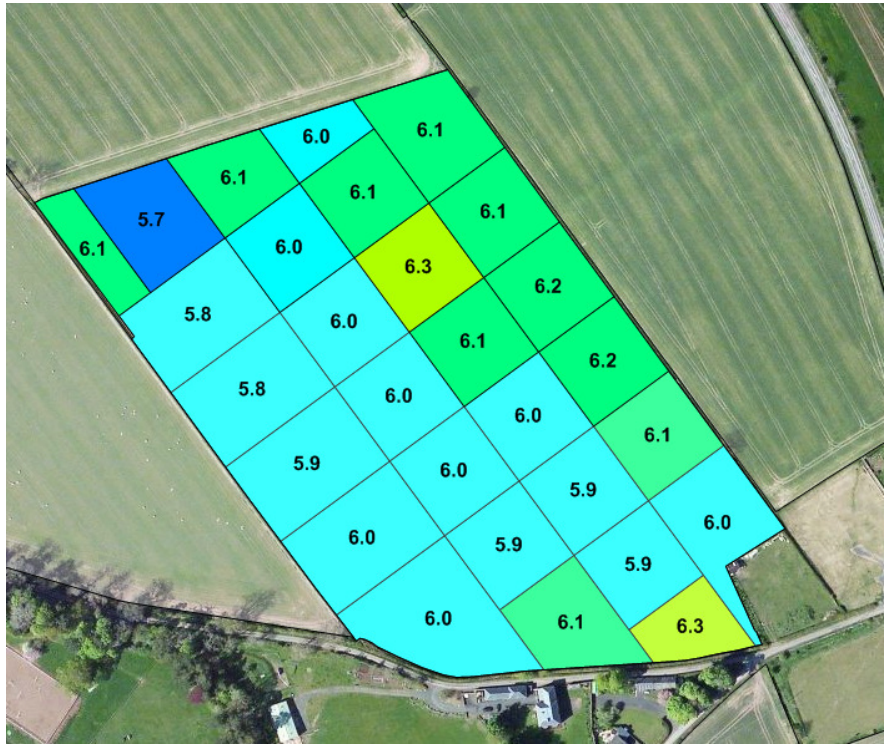

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Replacing off take – Spring Barley

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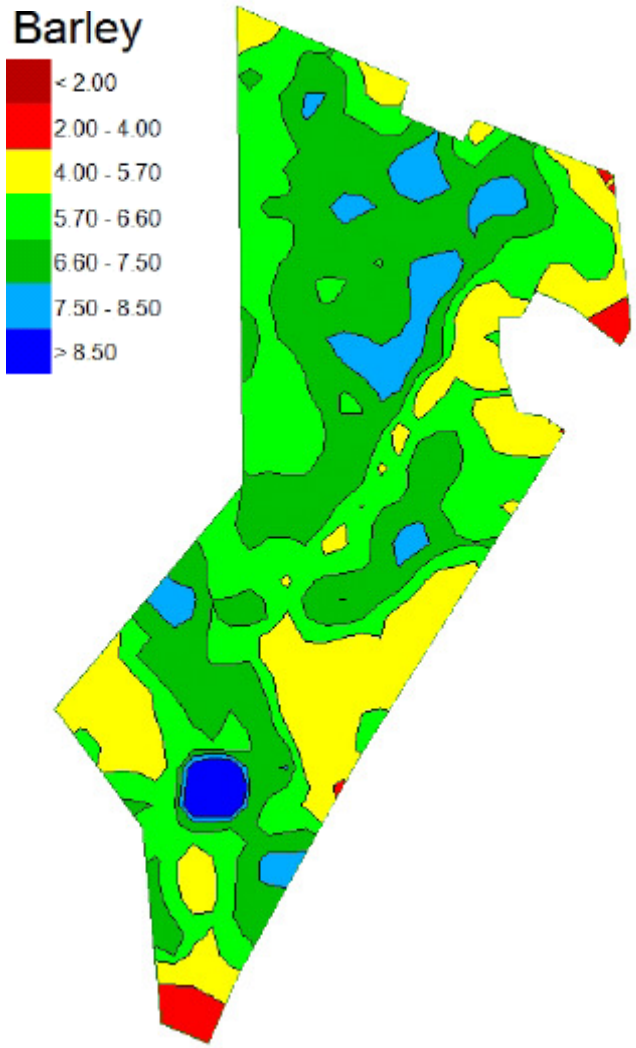
Yield (t/ha)	P (kg/ha)	K (kg/ha)
2.00	17	24
2.00 – 4.00 (3.00)	26	35
4.00 – 5.70 (4.90)	42	58
5.70 – 6.60 (6.2)	53	73
6.60 – 7.50 (7.00)	60	83
7.50 – 8.50 (8.00)	69	94
>8.50	73	100



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Grid Sampling

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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.

- Large amount of samples –
  - 12 sub samples from a grid in a circle about 15m from the grid centre
  - When 4 grids per ha get at least 1 sub-sample from every pass of the lime spreader
  - No matter which way the spreader passed through the grid.

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Grid Based Sampling

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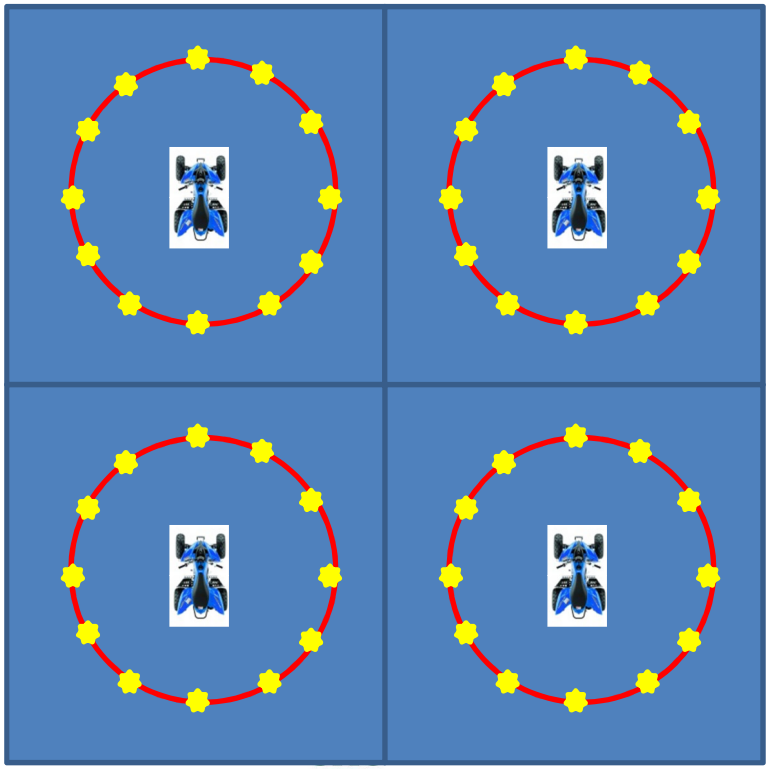
- 4 samples per ha
- 12 sub samples (48 per ha)



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Grid Based Sampling

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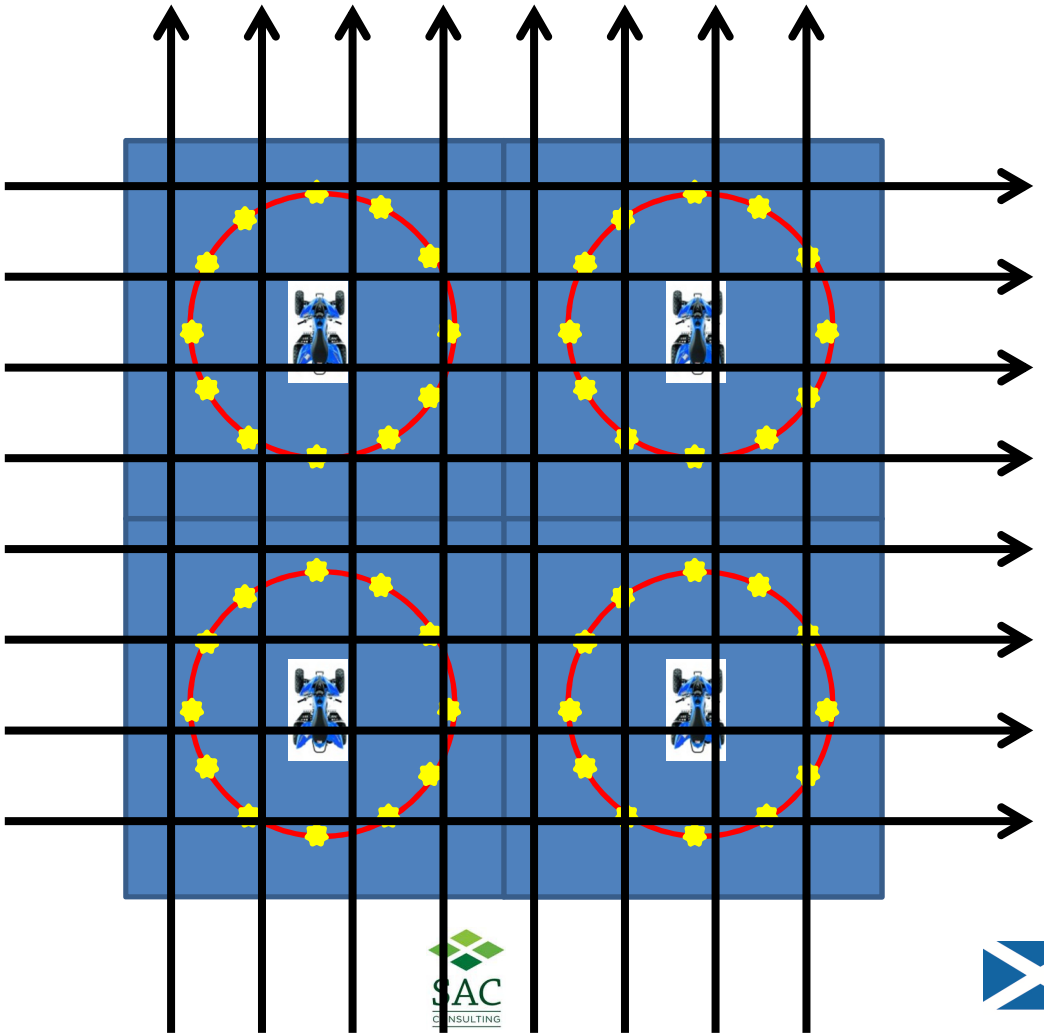

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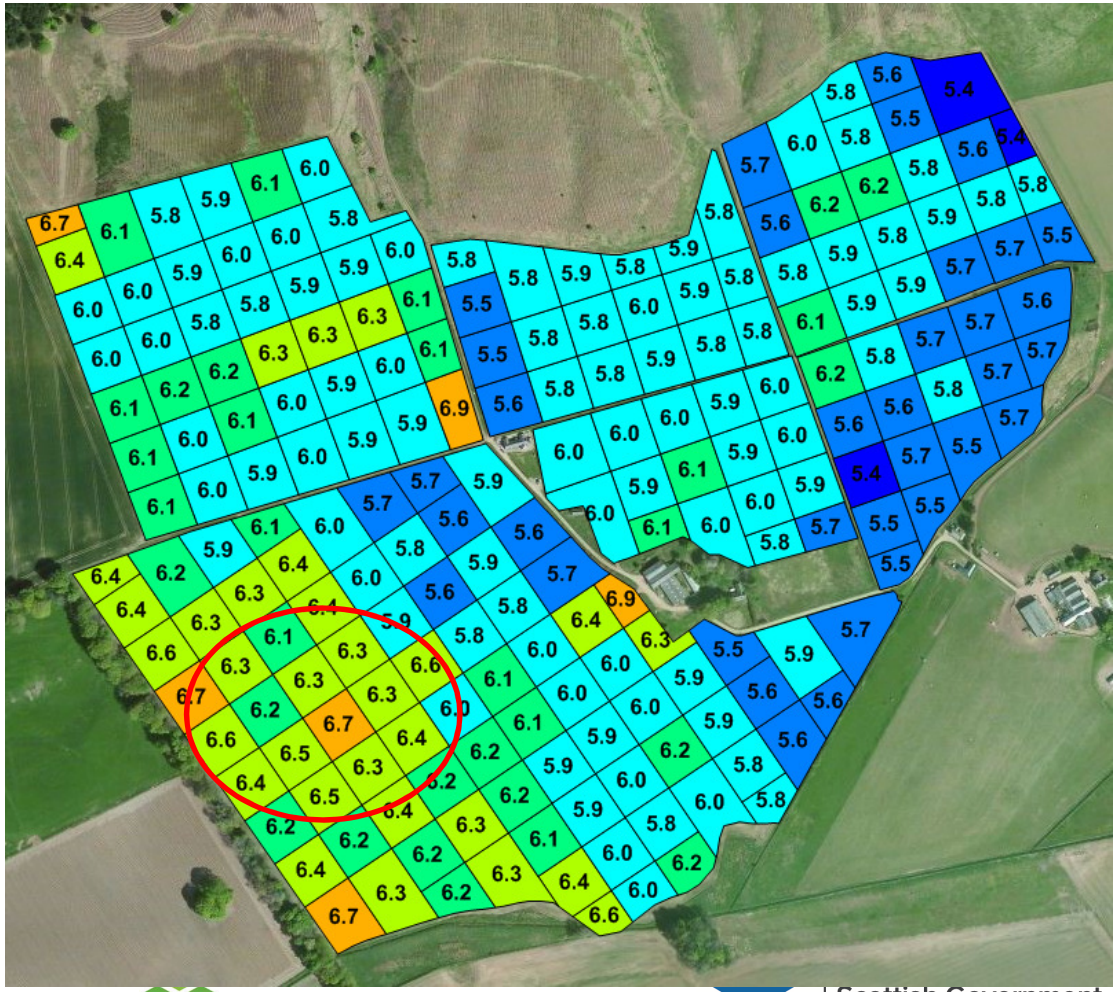
Map of grid areas

- Notice pH 6.7 bounded by

pH 6.2, 6.3, 6.4, 6.5

- Computer-generated map would not predict pH 6.7



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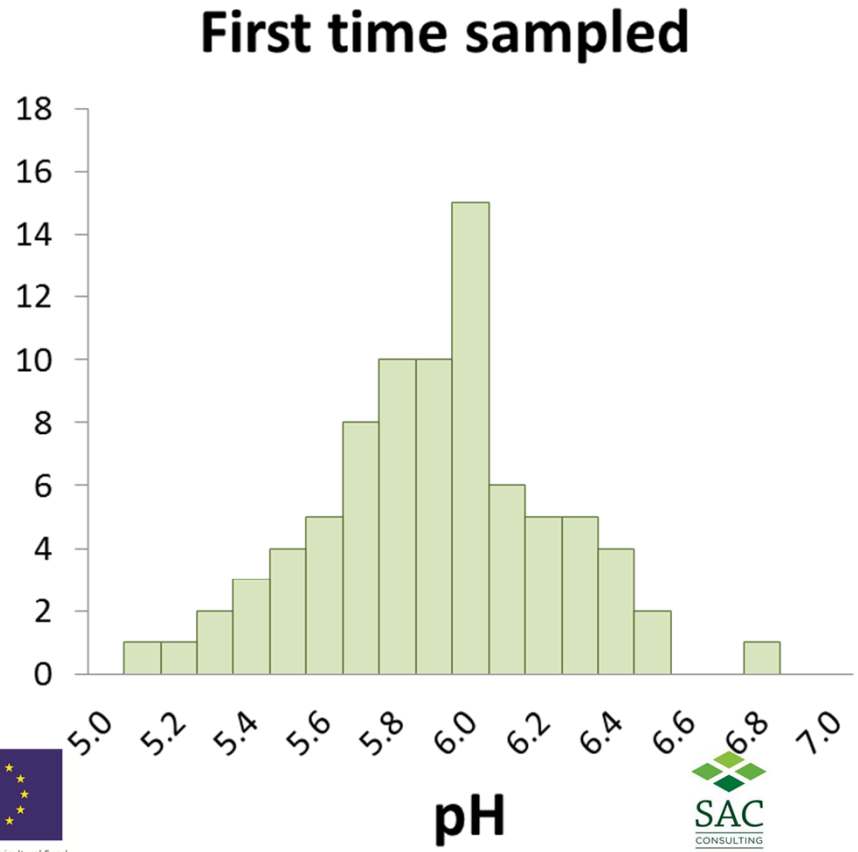
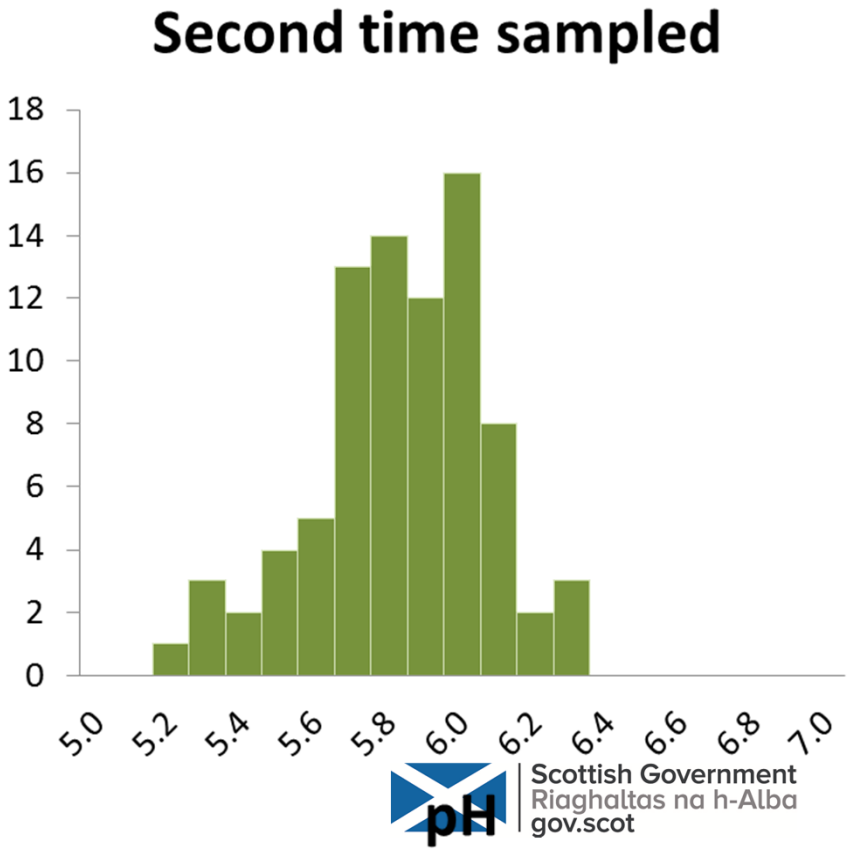
So what are we trying to achieve?

- Decrease variability
  - After the precision application of lime a field should have a more consistent pH





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Sampling rate

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- A higher sampling rate
  - Is more accurate
  - Reduces variability within fields
  - Is more expensive BUT still Pays

Remember the golden rules

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- 2 t/acre (5t/ha) maximum applied in one application
- If more required split the application
- Lime can take 18 months to fully neutralise
- Once pH is sorted move on to major nutrients

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Girrick: Conventional W – pattern

1 samples per acre or 2.5 per ha

7.59 ha x 2.5 = 19 cores per field for 1 field result

How Much Lime?

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Replace what is being taken off by the crop (TN633)

Crop	P Removal (kg/t)	K Removal (kg/t
Cereals Grain Only	7.8	5.6
WOSR Grain Only	14	11

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Conclusion

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- Tackle pH first – it's the key to productivity
- Use your own knowledge and information to hone how you sample for P and K
- Once you have got to the required status then use a nutrient balance to maintain the status
- Use yield information if available

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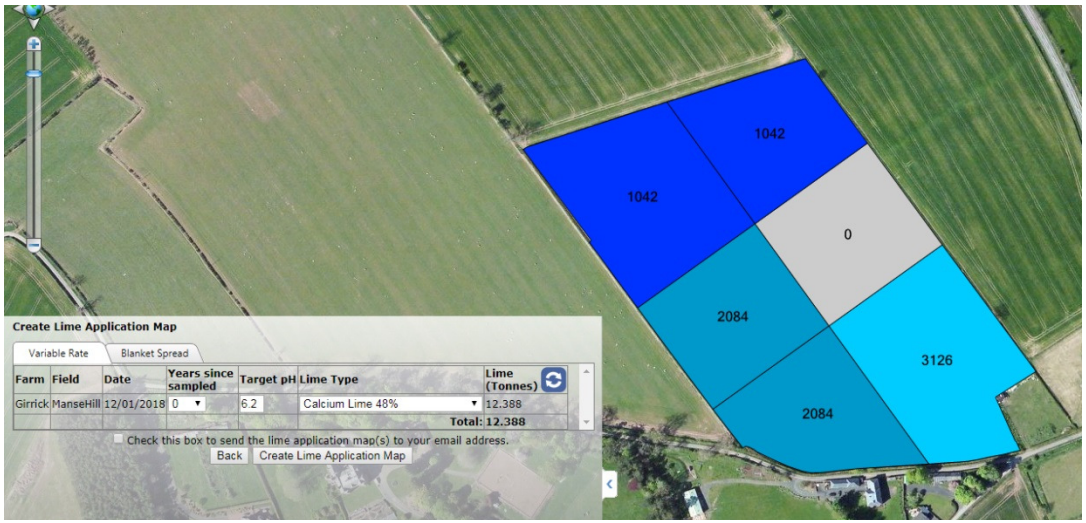

12.388 tonnes

15.456 tonnes

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Cost Comparison

Conventional Action		W Pattern		
Apply Lime at t/ha		4.00		
Total field T	30.00 t			
Calcium Lime Cost £/t Spread		£ 26.00		
Total cost		£ 789.36		
GPS Targeted Action		**1ha Grid**		**¼ ha Grid**
Lime required £20/t	12.39 t	£ 247.76	15.456 t	£ 309.12
Additional spread price £4/ha		£ 30.36		£ 30.36
Sampling cost		£ 75.90		£ 188.23
Total		£ 354.02		£ 527.71
Saving on Lime		£ 541.60		£ 480.24
Summary				
Net Field Saving Vs Conventional		**£ 435.34**		**£ 261.65**

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Thank You

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