Crop & Soil Analysis

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Location - Aucheneck Estate
Date 10th October 2019

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Offtake update

Trace Elements

Soil Analysis

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Offtake Update

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Field 1 – 2nd Cut

- Offtake 2nd cut

- P_2O_5 – Planet 1.70kg/t, Aucheneck 2.38kg/t
  - 20 29
- K_2O – Planet 6.0kg/t, Aucheneck 8.62kg/t
  - 72 103

Field 2 – 2nd Cut

- Offtake 2nd cut 12t/ha

- P_2O_5 – Planet 1.70kg/t, Aucheneck 2.13kg/t
  - 20 26
- K_2O – Planet 6.0kg/t, Aucheneck 8.56kg/t
  - 72 103

Arable Silage

- Offtake Winter Wholecrop
- P_2O_5 – Planet 1.8kg/t, Aucheneck 1.92kg/t
- K_2O – Planet 5.4kg/t, Aucheneck 4.9kg/t

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Trace Elements

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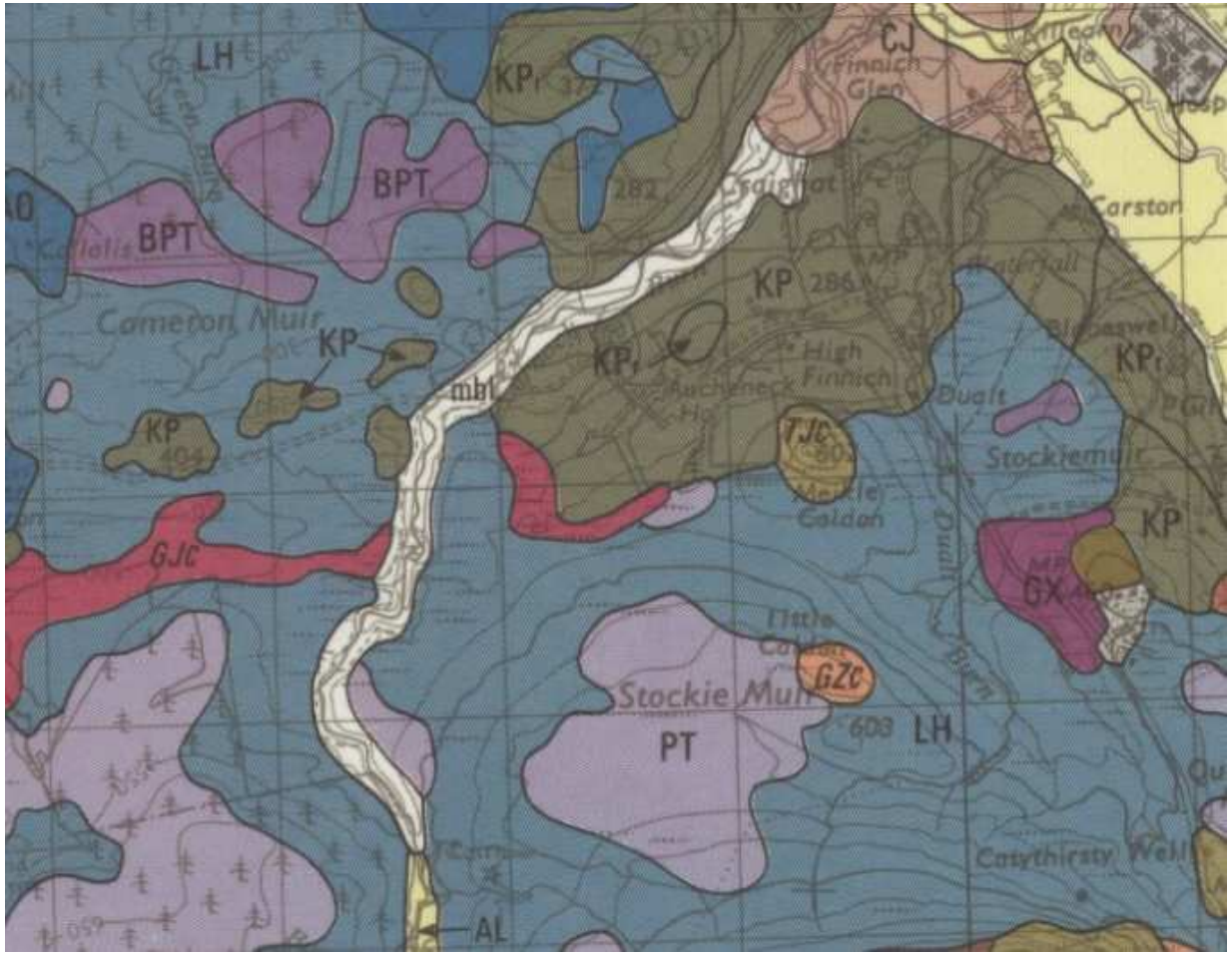
What are they

- Minerals in small quantities in the soil e.g.
    - Cu, B, Fe, Co, Al, Mo, Mn, Zn etc
- Essential for normal health and function
- Both in Crops and Livestock

What influences the availability

- Soil type
- pH
- Drainage
- Trace element interaction

Soil Type - Soil Map



Soil Type

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SOIL ASSOCIATIONS AND SERIES

ASSOCIATION	PARENT MATERIAL	Brown Forest Soils: Freely Drained	Brown Forest Soils: Imperfectly Drained	Humus-Iron Podzols: Freely Drained	Peaty Podzols: Imperfectly Drained	Noncalcareous Gleys: Imperfectly Drained	Noncalcareous Gleys: Poorly Drained	Peaty Gleys: Poorly and Very Poorly Drained
KIPPEN	Drifts derived from sandstones of Upper Old Red Sandstone age with some Dalradian schist erratics	FK Fourmerk	KP Kippen	RD Redbrae	GX Garrique		AO Arnmore	LH Limpithill
	Till, derived from rocks as above, with partially water-sorted upper layers		BW Butterwell				QL Quinloch	

	Freely Drained	Imperfectly Drained	Poorly Drained
MINERAL ALLUVIAL SOILS — Sandy	JC Culnacoyle	JK Kaime	JR Rockfield
Loamy	JP Peebles	JT Traquair	JL Lochside
Silty		JS Shandwick	JB Bindal
Clayey			JH Heavyside

ORGANIC SOILS

BASIN and VALLEY PEAT › 50cm	B PT
BLANKET PEAT › 50cm	PT

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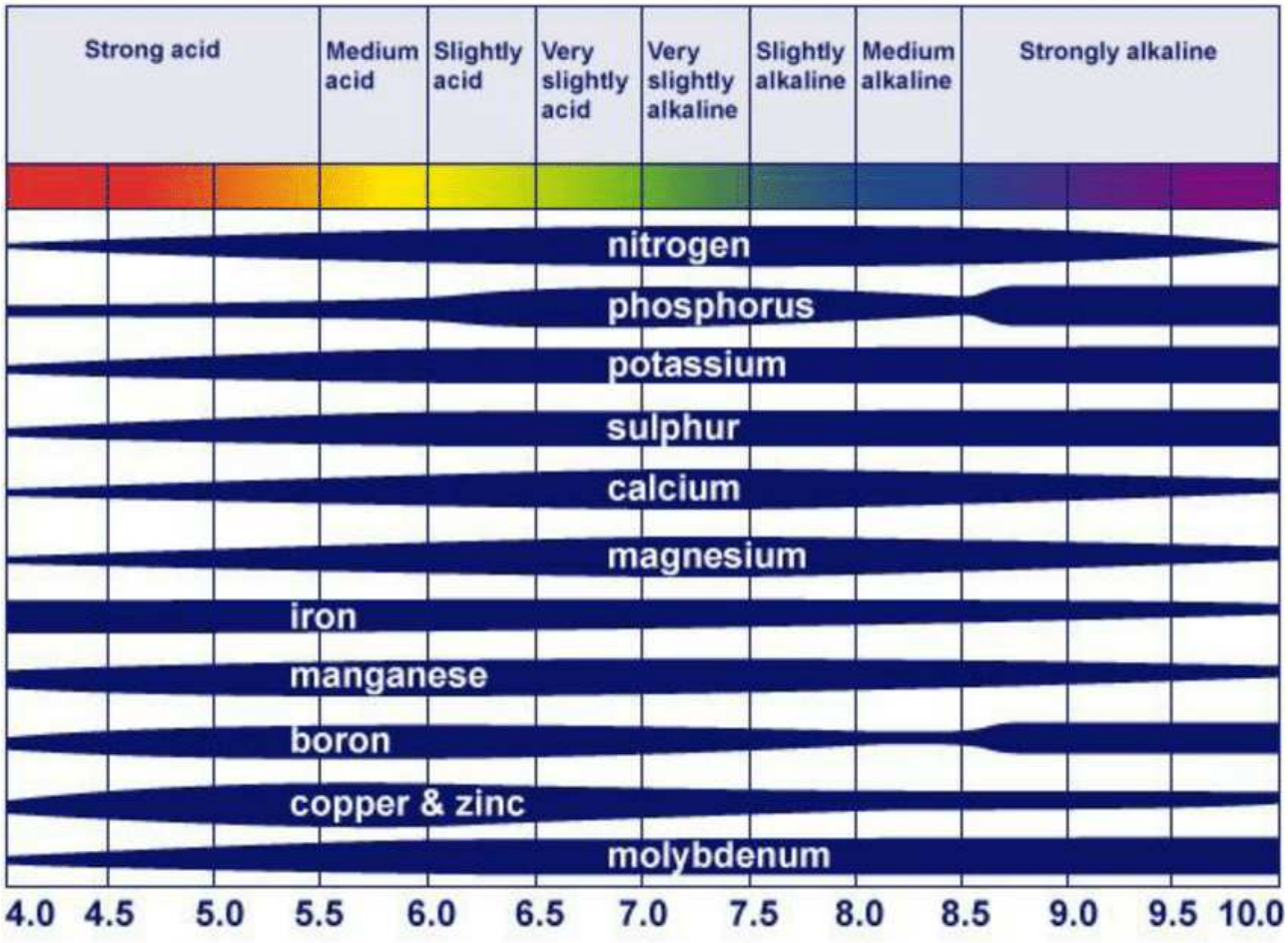
Availability with pH



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Drainage

- Free draining soils contain less trace elements than poorly drained soils

Copper

- Amount absorbed from diet very variable
- Excess stored in liver
- If a large amount ingested or injected – toxic
- Diagnosis – blood or liver
- Pasture levels – can vary depending on interference of Cu, Mo, S can affect availability and absorption
- Soil Test – a guide

Cobalt

- Essential component of Vit B_{12}
- Diagnosis – blood or liver
- Pasture levels – can vary by pH, Fe and Mn
- Moredun indicated upland/ moorland pastures with pH < 5 may have Cobalt poorly absorbed.
- Clover higher than ryegrass and higher in Autumn than Spring

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Cobalt - Soil

- Soil test – a guide
- Soil Co higher level than pasture
- Liming increases pH – reduces concentration of Co in grass
- Can induce Co deficiency on improved grass
- Faster growing grass – less cobalt

Selenium

- Acts with Vit E to prevent oxidation of tissues
- Diagnosis – blood/ enzymes
- Excess toxic but very rare
- Clover less than ryegrass
- Herbage analysis misleading
- Soil Test – direct relationship between soil, herbage and animal
- Sulphur over use can exacerbate a marginal deficiency

Iodine

- Important part of control in energy metabolism
- Diagnosis – blood or PM
- Level varies on species, soil type, fertiliser treatment.
- Soil Test – no clear relationship between soil and herbage
- Improved grass often better than unimproved

Manganese

- Important for several enzyme functions
- Levels vary widely in pasture, soil pH has a major effect on plant uptake
- Clover higher than grass
- Soil test useful as pH over 6.5 will significantly reduce levels in pasture and crop

Zinc

- Throughout the body
- Clinical signs don’t usually appear until diet falls well below required levels
- Animal needs continuous supply
- Soil Test - poor

Aucheneck

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Trace Element Levels in Pasture

	Field 1 at Aucheneck	Field 2 at Aucheneck	Whole Crop	Typical average levels in UK pasture	Recommended minimum levels in pasture to prevent deficiency	Recommended levels in the total diet
	mg/kg DM	mg/kg DM	mg/kg DM	mg/kg DM	mg/kg DM	mg/kg DM
Copper*	7.12	5.28	4.46	8	5**/ 8***	10
Cobalt	0.09	0.12	0.08	0.1	0.11**/ 0.08***	0.12
Selenium	0.05	0.03	0.03	0.07	0.05	0.1
Iodine				0.15	0.2^/ 0.5^^	0.5
Managnese	127	171	63.7	100	25	50
Zinc	22.2	21.1	22.3	50	25	50

* depends on level of Molybdenum, suplhur and iron

** Sheep Grazing *** Cattle grazing

^ growing & dry stock ^^ pregnant and lactating stock

Standard figures courtesy of AHDB

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Re-cap

- Man-made improvements can have an effect
- Rich permanent pasture diverse in species will have a higher concentration, whereas a monoculture of productive grasses will have less
- Increasing pH with lime reduces the cobalt concentration in the grass. It also increases the molybdenum concentration which reduces the available copper to the animal

How do we test for deficiency

- Soil test? – a guide
- That only tells us what is in the soil not necessarily the plant or the animal.
- It can be an indicator – a low level could mean a high possibility of deficiency.
- But a moderate to high level may not mean the animal is getting an adequate level
- If in doubt speak to your Consultant or Vet

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Soil Analysis

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Soil Analysis

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- Check you are using the right analysis for your soil
- There is a difference in techniques between (England, Wales & N Ireland) and Scotland
- Scottish Laboratories use calcium chloride for pH and modified morgan for P & K
- “Non Scottish” laboratories use water for pH and Olsen extraction for P and Ammonium Nitrate for K

Why & what does this mean

- The “Scottish” system was developed by the then Macaulay Institute for our Scottish acidic soils as opposed to the more alkaline soils south of the border
- Interpretation is therefore different as they give different values.
- However, there is a comparison that can be made.

pH Results

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- Because of the two different measurements interpretation differs

	England, Wales and N Ireland[1]		Scotland[2]	
	Optimum soil pH			
	Mineral soils	Peaty soils	Mineral soils	Peaty soils
Continuous arable cropping	**6.5***	**5.8**	**6.0-6.2**	**5.7-5.9**
Continuous grassland	**6.0**	**5.3**	**6.0**	**5.3-5.5**

- So optimum pH varies
- The same analysis should be used each time

P & K “Not Scotland”

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PHOSPHORUS		POTASSIUM		MAGNESIUM	
Olsen extraction		Ammonium nitrate extraction			
Olsen P		exchangeable K		exchangeable Mg	
Index	mg/l	Index	mg/l	Index	mg/l
0	0-9	0	0-60	0	0-25
1	10-15	1	61-120	1	26-50
2	16-25	2-	121-180	2	51-100
		2+	181-240		
3	26-45	3	241-400	3	101-175
4	46-70	4	401-600	4	176-250
5	71-100	5	601-900	5	251-350
6	101-140	6	901-1500	6	351-600
7	141-200	7	1501-2400	7	601-1000
8	201-280	8	2401-3600	8	1001-1500
9	over 280	9	over 3600	9	over 1500

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P & K “Scottish”

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SAC Status	PHOSPHORUS	POTASSIUM	MAGNESIUM
	Modified Morgans extraction		
	mg/l	mg/l	mg/l
Very low (VL)	0.0-1.7	0-39	0-19
Low (L)	1.8-4.4	40-75	20-60
Moderate - (M-)	4.5-9.4	76-140	61-200
Moderate + (M+)	9.5-13.4	141-200	61-200
High (H)	13.5-30.0	201-400	201-1000
Very high (VH)	>30.0	>400	>1000

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Comparing P

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Olsen		Modified Morgan	
Index	Concentration range (mg P L^{-1})	Status	Concentration range (mg P L^{-1})
0	0 – 9	Very low	<1.8
1	10 -15	Low	1.8 – 4.4
2	16 – 25	Moderate	4.5 – 13
3	26 – 45	High	14 – 30
4	46 – 70	Very high	>30
5	71 – 100		
6	101 – 140		
7	141 – 200		
8	201 – 280		
9	>280		

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Comparing K

Ammonium Nitrate		Modified Morgan	
Index	Concentration range (Mg K L^{-1})	Status	Concentration range (Mg K L^{-1})
0	< 60	Very low	< 39
1	61 - 120	Low	40 - 75
2	121 - 240	Moderate	76 - 200
3	241 - 400	High	201 - 400
4	401 - 600	Very High	> 400
5	601 - 900		
6	901 - 1500		
7	1501 - 2400		
8	2401 - 3600		
9	> 3600		

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Yield response

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Crop response and soil analysis

Defra Index	SAC description	Yield response to added nutrient by vegetable crops	arable crops and grass
0	Very low	highly likely	highly likely
1	Low	highly likely	probable
2	Moderate	likely	unlikely
3	High	possible	nil
4	Very High	unlikely	nil
5	Very High	nil	nil

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Sampling Soil

- GPS is probably best due to the frequency of sampling but only if the kit to use it
- If not make sure the sample is representative, you are taking 1kg of soil to represent 2000 tonnes/ha (at a depth of 20 cm).
- Sample to 15cm arable soil and about 7.5cm in grassland
- Ensure the soil tests labs are giving “Scottish” results

Finally - do not sample

- within:
  - 8 weeks of fertilising – P & K
  - 12 weeks slurry/fym – P & K
  - 12 months of liming - pH

Thank You

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