Soil & Manure Nutrients

March 2020

"The Nation that destroys its soil destroys itself."
Franklin Delano Roosevelt (1937)

"Essentially, all life depends upon the soil ... There can be no life without soil and no soil without life; they have evolved together."
Charles E. Kellogg (1938)

SOILS

Do we have the Tools?

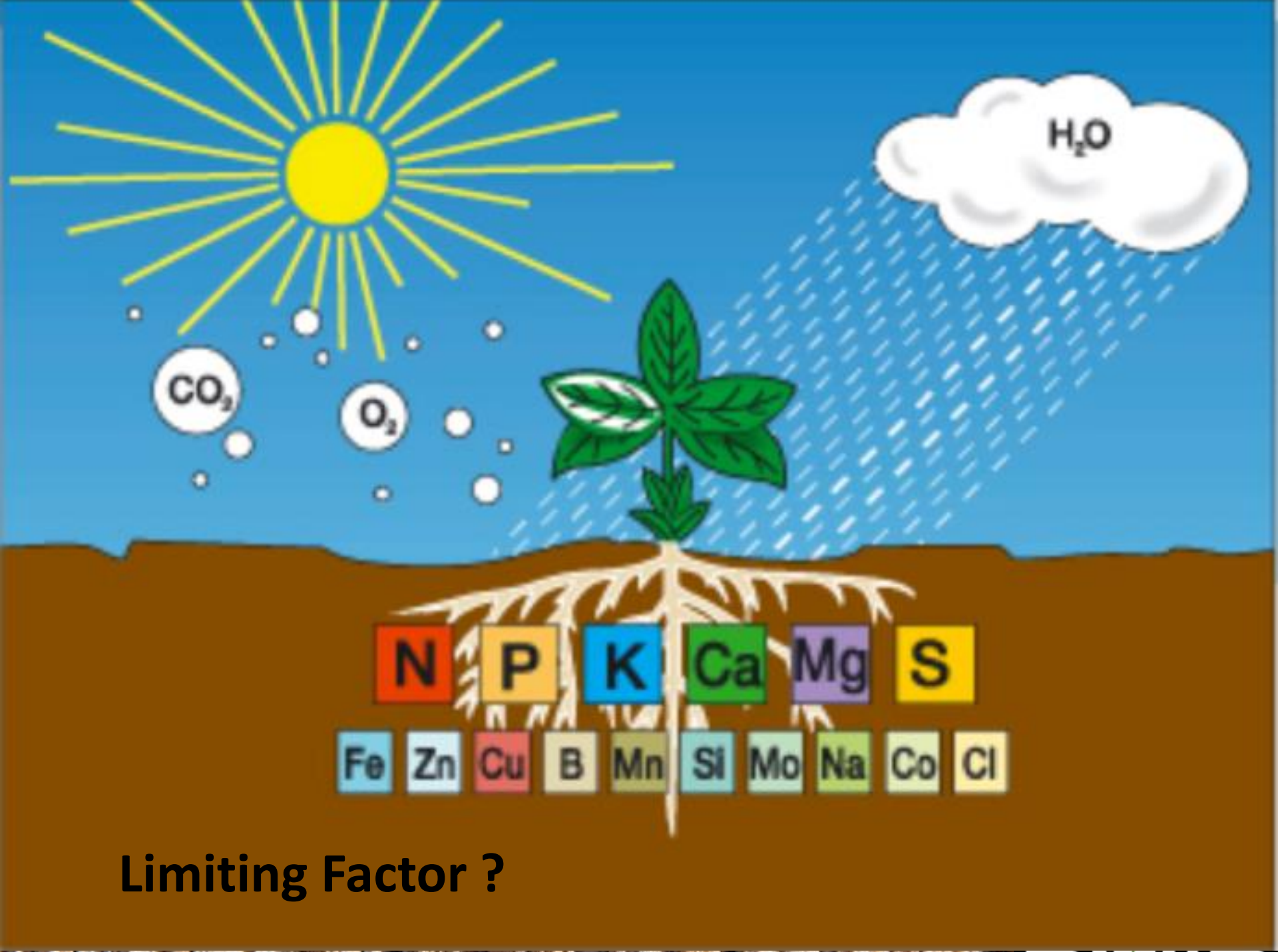
But do we know what to do with them?

Nutrient Budget

Where do you start

Create a Base Line

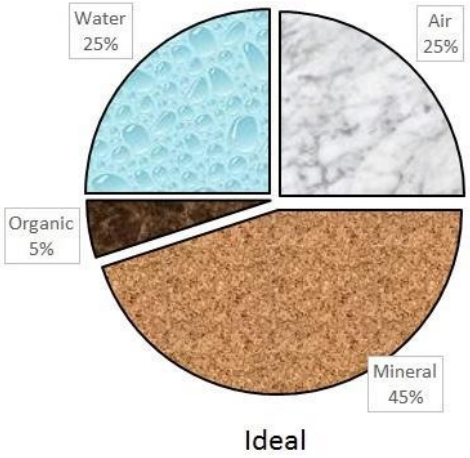
- Soil Structure & Soil Type
- Detailed Soil Analysis
- Available Nutrients – Manures & Fert
- What's the Analysis
- NVZ regulations - Stock numbers & Area
- Crop Requirement



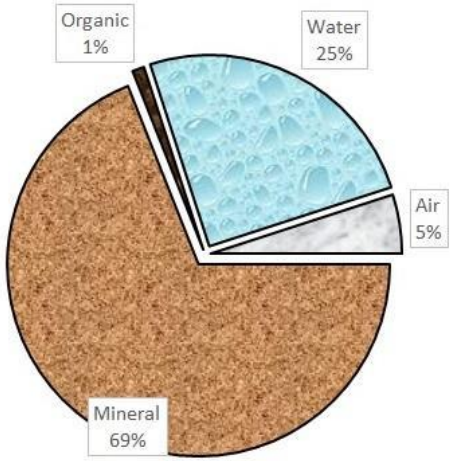
Limiting Factor ?

Soil Condition

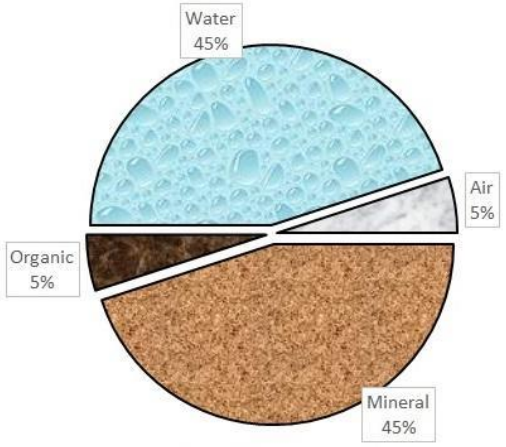
How much Air?



Ideal



Compacted



Poorly Drained

The soils Chemistry effects the Physics which determines the Biology

Factors Affecting Soil pH

- Soil type
- Organic Matter
- Fertiliser Type & Rate
- Slurry & Manure applications
- Rainfall
- Calcium
- Magnesium x 1.67
- Potassium x 2
- Sodium x 4
- Other Cations (Al, Fe, NH_4, Cu, Zn)

1991 Specification

Sieve Size	Ground Lime	Screened Lime	Course Screened
5mm	100	100	100
3.35	95	95	90
150 micron	40	20	15

KIWA PAI
The Inspire
Hornbeam Square West
Harrogate
North Yorkshire
HG2 8PA

ALLIANCE TECHNICAL LABORATORIES
Analytical & Consultant Chemists & Microbiologists

Laboratory Test Report
Agricultural Liming Association - Quality Protocol

Sample producer: **LEITHS (SCOTLAND) LIMITED**
Production site: **Parkmore Quarry, Dufftown**
KIWA Site Reference Number: **TBA**
Purchase order or other ref: **Not provided**
Report date: **07 January 2019**
Report ref. **ATLL41747-2** page 1 of 1
Sample as received date: **13 December 2018**
Laboratory sample number: **188461**
Sample category: **Screened Limestone.** Material Trade Name: **Screened Agricultural Limestone.**
Sample date: **04 December 2018**

Reactivity 66.5 %
- method: BS EN 13971:2012 (Hydrochloric acid) - code GN

Neutralising Value 47.7 % m/m as CaO% as received - method: Ferts (S&A) 1996 - code GN
EU Regs = Limit 42% min CaO for standard, 50% min CaO for fine

Particle Size Distribution
- Wet sieving - code GN

Sieve size	Percent less than sieve size		Limits (UK Regulations) Screened Limestone	Limits (EU Regulations) Fine quality	Limits (EU Regulations) Standard quality
5.0mm	100.0	% m/m	Pass - limit 100% min		
3.35mm	96.7	% m/m	Pass - limit 95% min		
3.15mm	96.2	% m/m			Fail - Limit 97% min
2.00mm	83.0	% m/m		Fail - Limit 97% min	
1.00mm	69.2	% m/m		Fail - Limit 80% min	Fail - Limit 80% min
0.600mm	59.1	% m/m			
0.500mm	53.7	% m/m			Pass - Limit 50% min
0.315mm	44.2	% m/m		Fail - Limit 50% min	
0.150mm	31.4	% m/m	Pass - limit 20% min		
0.100mm	24.6	% m/m			

Moisture 2.07 % m/m
- method: Ferts (S&A) 1996 - code GN

Calcium 34.6 % m/m as Ca 48.4 % m/m as CaO
- method: BSEN12946:2000 code GN

Magnesium 0.69 % m/m as Mg 1.15 % m/m as MgO
- method: BSEN12946:2000 code GN Pass - limit 15% MgO

Report by: S. Johnson
Alliance Technical Laboratories Limited
Tel. 01449-721192

Analysis status code
U = Analysis is UKAS accredited
N = Analysis is not UKAS accredited
G = Analysis was carried out by ATLL
S = Analysis was sub-contracted to another laboratory
Any opinions or interpretations are outside the laboratory's UKAS accreditation

RAF

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SOILS

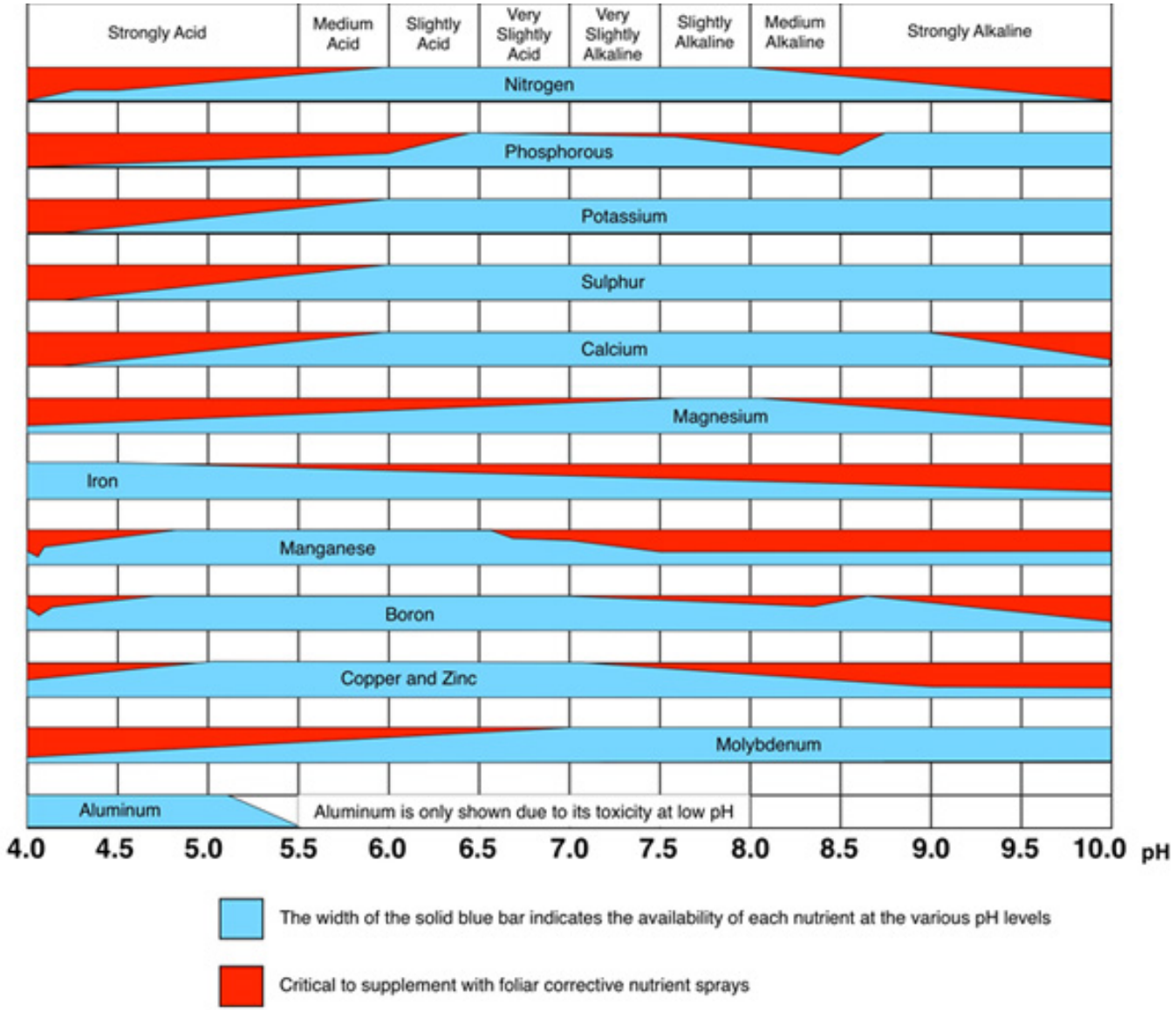
2.AQS Result

Laboratory Test Report

Purchase order ref: **06/2017LC**
Report date: **20 July 2017**
Report ref. **ATLL34734#1** page 1 of 1
Sample as received date: **14 March 2017**
Laboratory sample number: **164350**
Sample producer: I
Sample Certificate number - Sample number: **112693 - 1650**
Sample date: **19/12/2016,** Material: **Screened AgLime,** Location: **Stockpile**

Results of analysis:

Reactivity	49.7	%	
- method: BS EN 13971:2012 (Hydrochloric acid) - code GN			
Neutralising Value as CaO % as received	40.4	% m/m	
- method: Ferts (S&A) 1996 - code GN			
Particle Size Distribution			
- UK methods, wet sieving - code GN	Percent less than sieve size		
45mm	100.0	% m/m	
6.3mm	100.0	% m/m	
5.0mm	100.0	% m/m	pass - limit 100% min
3.35mm	98.5	% m/m	pass - limit 95% min
0.600mm	57.2	% m/m	
0.150mm	31.3	% m/m	pass - limit 20% min
0.100mm	23.9	% m/m	
Moisture as received	1.2	% m/m	
- method: Ferts (S&A) 1996 - code GN			
Calcium content as received	26.6	% m/m as Ca	
- method: BS EN 13475:2002 code GN	37.2	% m/m as CaO	
Magnesium content	0.81	% m/m as Mg	
- method: BS EN 12947:2000 code GN	1.35	% m/m as MgO	pass - limit 15% MgO max


Strongly Acid
Medium Acid
Slightly Acid
Very Slightly Acid
Very Slightly Alkaline
Slightly Alkaline
Medium Alkaline
Strongly Alkaline
Nitrogen
Phosphorous
Potassium
Sulphur
Calcium
Magnesium
Iron
Manganese
Boron
Copper and Zinc
Molybdenum
Aluminum
Aluminum is only shown due to its toxicity at low pH
4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0 9.5 10.0 pH
The width of the solid blue bar indicates the availability of each nutrient at the various pH levels
Critical to supplement with foliar corrective nutrient sprays


SOILS

Be Careful of Your Index!

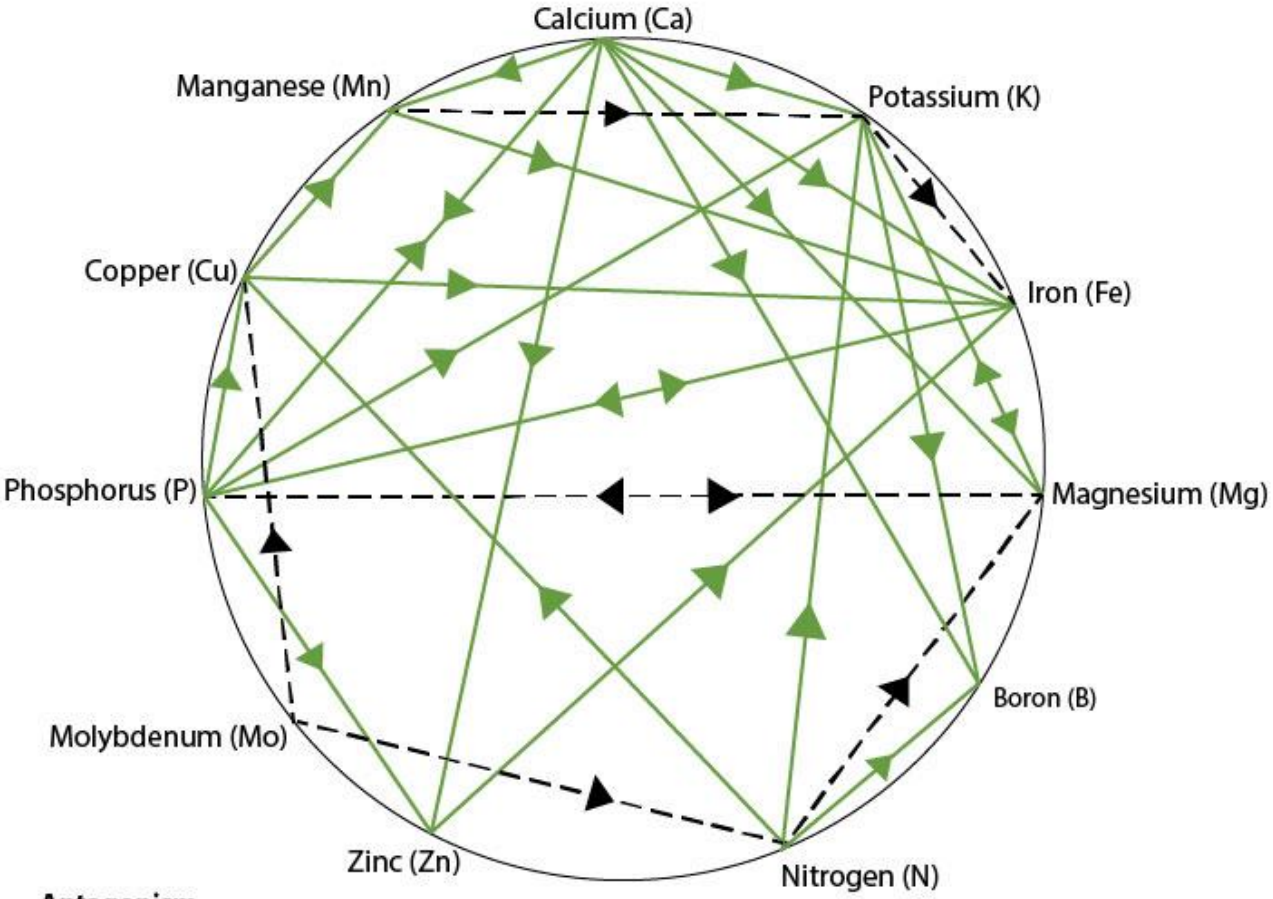
Index	Phosphorus (P)	Potassium (K)	Magnesium (Mg)
	Olsen P	Ammonium nitrate extract	
	mg/litre		
0	0–9	0–60	0–25
1	10–15	61–120	26–50
2	16–25	121–180 (2-) 181–240 (2+)	51–100
3	26–45	241–400	101–175
4	46–70	401–600	176–250
5	71–100	601–900	251–350

SAC (Modified Morgan's) Index System

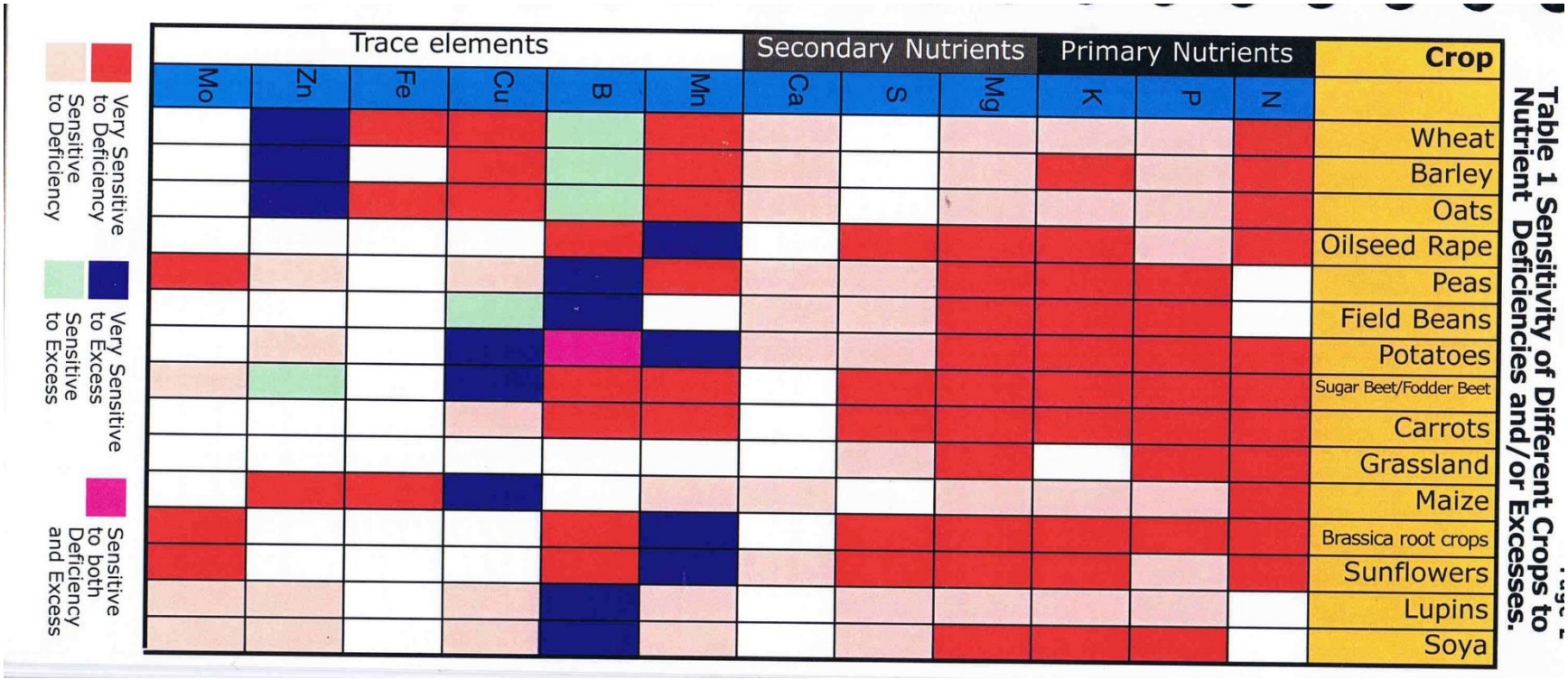
This table shows the SAC Consultancy soil interpretations scales using the Modified Morgan's extraction methodology.

Status	Phosphorus (mg/litre)	Potassium (mg/litre)	Magnesium (mg/litre)	Equivalent ADAS Index
Very low (VL)	< 1.8	0 - 39	0 - 19	0
Low (L)	1.8 - 4.4	40 - 75	20 - 60	1
Moderate (M-)	4.5 - 9.4	76 - 140	61 - 200	2
Moderate (M+)	9.5 - 13.4	141 - 200	61 - 200	3
High (H)	13.5 - 30	201 - 400	201 - 1000	4 - 5
Very High (VH)	> 30	> 400	> 1000	6 - 9

Mulders Chart



Crop Sensitivity



SOILS

Sample Ref 304

Sample No E273410/07 / S1000585

Crop NON STATED

Soil Characteristics	Result
pH	6.1
Org. Matter - DUMAS (%)	7.5
Lime Req. (t/ha)	5.0
C.E.C. (meq/100g)	12.7
Major Nutrients	**Result**
Phosphorus (ppm)	122
Potassium (ppm)	335
Magnesium (ppm)	188
Secondary and Micro Nutrients	**Result**
Calcium (ppm)	1579
Sulphur (ppm)	8
Sodium (ppm)	38
Boron (ppm)	1.02
Copper (ppm)	20.3
Iron (ppm)	876
Manganese (ppm)	25
Molybdenum (ppm)	0.04
Zinc (ppm)	28.6

Sample No E385006/04
Crop SILAGE

Analysis	Result	Guideline	Interpretation	Comments
pH	6.8	6.0	Normal	Adequate level. Maintain pH to ensure optimum nutrient nutrient availability and ideal conditions for an active soil biology.
Phosphorus (ppm)	22	16	Normal	**(Index 2.6)** 1st Cut: 40 kg/ha P2O5 (32 units/ac) 2nd Cut: 25 kg/ha P2O5 (20 units/ac) 3rd Cut: 15 kg/ha P2O5 (12 units/ac) 4th Cut: 10 kg/ha P2O5 (8 units/ac)
Potassium (ppm)	109	121	Low	**(Index 1.8)** 1st Cut: 30 kg/ha K2O (24 units/ac) applied in autumn followed by 80 kg/ha K2O(64 units/ac) in spring 2nd Cut: 100 kg/ha K2O (80 units/ac) 3rd Cut: 80 kg/ha K2O (64 units/ac) 4th Cut: 70 kg/ha K2O (56 units/ac) Apply an extra 60 kg/ha K2O following the last cut in 1 and 2 cut systems or 30 kg/ha K2O following last cut in a 3 cut system.
Magnesium (ppm)	204	51	Very High	**(Index 4.3)** Possible interference with availability of Potassium.
Calcium (ppm)	2542	2000	Normal	Adequate level.
Sulphur (ppm)	4	10	Very Low	Consider treatment for optimum grass yield and quality.
Manganese (ppm)	48	60	Slightly Low	Consider treatment for optimum grass growth.
Copper (ppm)	5.4	8.0	Low	PRIORITY FOR LIVESTOCK HEALTH (see comments below).
Boron (ppm)	1.43	0.50	Normal	Adequate level.
Zinc (ppm)	7.0	7.0	Normal	Adequate level.
Molybdenum (ppm)	0.04	<0.5	Slightly Low	No problems anticipated.
Iron (ppm)	1351	50	Normal	Adequate level.
Sodium (ppm)	33	90	Very Low	PRIORITY FOR LIVESTOCK HEALTH (see comments below).
C.E.C. (meq/100g)	17.6	15.0	Normal	Cation Exchange Capacity indicates a soil with a good nutrient holding ability.

Analysis	Result	Guideline	Interpretation	Comments
pH	7.0	6.0	Normal	Adequate level. Maintain pH to ensure optimum nutrient nutrient availability and ideal conditions for an active soil biology.
Phosphorus (ppm)	32	26	Normal	**(Index 3.3)** 20 kg/ha P2O5 (16 units/acre).
Potassium (ppm)	278	241	Normal	**(Index 3.2)** Monitor potassium using fruitlet and fruit analysis.
Magnesium (ppm)	503	120	High	**(Index 6.6)** Possible interference with availability of Potassium.
Calcium (ppm)	3002	2000	Normal	Moniter calcium using fruitlet and fruit analysis.
Sulphur (ppm)	5	10	Low	Low priority on this crop. Other crops may be affected.
Manganese (ppm)	50	70	Low	PRIORITY FOR TREATMENT.
Copper (ppm)	6.3	4.1	Normal	Adequate level.
Boron (ppm)	1.78	2.10	Slightly Low	PRIORITY FOR TREATMENT.
Zinc (ppm)	29.3	5.0	High	Possible interference with the availability of Iron.
Molybdenum (ppm)	0.08	0.30	Very Low	Low priority on this crop. Other crops may be affected.
Iron (ppm)	820	200	Normal	Adequate level.
Sodium (ppm)	38	90	Very Low	Not a problem for this crop.
C.E.C. (meq/100g)	22.9	15.0	Normal	Cation Exchange Capacity indicates a soil with a good nutrient holding ability.

0	Ian Robertson	FACTS Fertiliser Advisor			
0	07970 286420	Ian Robertson	0	07970 286420	

Field ID: NEXT TO CORNER | 1 Ha | **Crop Sown:** Grass (Grazed) | 12

pH

For lime recommendations edit the crop and soil type from the drop down box → Consult your SSM advisor for lime guidence

Active ph	8.20	0.0

The following recommendatons are based on | Rec's for a soil depth of approx | General plough depth | with | an Ideal soil structure

Major Cations

(Estimated CEC) 8.14		Desired kg/ha	Found kg/ha	(+or-) kg/ha	SSM Target %	Calculated BCS%	Clay % / Sand % — soil particles not analysed
Calculations for the Basic UK extraction methods.	Calcium (Ca)	2127	2721	594	67.00	85.72	
	Magnesium (MgO)	409	95	-314	13.00	2.97	Maintain foliar Mg
	Potassium (K2O)	351	260	-91	4.72	3.50	Question crop peak demands for K2O
	Sodium (Na)	44	323	280	0.89	6.81	Reduce sodium. Use sulphur
	Hydrogen % (Calc)				6.39	0	
	Other Cations (Calc)				8	1.00	
Target Ca:Mg Ratio 5.15	result 28.91	Ca:Mg BS% 80%			80	88.68	Ca:Mg saturation is high

OM

Organic Matter (LOI) min	>3%	4.25	Maintain Organic good matter levels
Active Carbon		0.00	0
Min required OM for structural integrity	3		

CROSS 1.19 <0.5

Anions

		Index	Found kg/ha	Target kg/ha	(+or-)	Treatment
Olsen P	Phosphate (P2O5)	4	280	112	167.9	excessive solution P
		0		0	0.00	
	Sulphate (So3) below detectable levels		179.5	78	101.5	

Trace Elements PPM

Availabile trace elements to roots			Guide range		Soil Treatments	Foliar treatment
Hot water	Boron (B)	mg/l	1.2 to 2.4	1.1	Apply Granular Boron	High Boron demanding crops only
M3	Iron (Fe)	mg/l	19 to 189	392	Apply products that create new roots	0
M3	Manganese (Mn)	mg/l	18 to 70	25		Q: lockup
M3	Copper (Cu)	mg/l	2.5 to 7	6.0	Consider maintenance levels of copper.	
M3	Zinc (Zn)	mg/l	4 to 10	12.1	.	
	Chloride (Cl)	mg/l	20 to 50	0.9		0
Hot water	Iodine (I)	mg/l	1 to 1	0		0
M3	Molybdenum (M	mg/l	0.5 to 0.5	N/A	N/A	
M3	Cobalt (Co)	mg/l	0.5 to 2	<0.2		0

RB209

mg/l		UK Index		RB209 av: yield crop recommendations		
62.6	Phosphate	4	kg/ha	0	16.8 off take	
111.2	Potash	1	kg/ha	30	57.6	
3.8	K:Mg Ratio too high			Apply foliar Magnesium		
29.45	Magnesium	1	kg/ha	0		

Advisor Comments

Potential staggers risk.

Field ID:	1ST RIGHT	1	Ha	Crop Sown:	No Crop Given	0

pH

For lime recommendations edit the crop and soil type from the drop down box → Consult your SSM advisor for lime guidence

Active ph	6.50	0.0

The following recommendatons are based on Rec's for a soil depth of approx General plough depth with an Ideal soil structure

Major Cations

(Estimated CEC)	9.33	Desired kg/ha	Found kg/ha	(+or-) kg/ha	SSM Target %	Calculated BCS%	Clay % / Sand %	soil particles not analysed
Calcium (Ca)		2456	2493	37	67.50	68.51		
Magnesium (MgO)		450	405	-45	12.50	11.06		Maintain foliar Mg
Potassium (K2O)		351	603	252	4.12	7.08		only apply crop requirement K
Sodium (Na)		50	78	28	0.89	1.44		
Hydrogen % (Calc)					6.99	9		
Other Cations (Calc)					8	2.90		
Target Ca:Mg Ratio	5.40	result	6.19	Ca:Mg BS% 80%	80	79.58		Acceptable Ca:Mg saturation

Calculations for the Basic UK extraction methods.

OM

Organic Matter (LOI) min	>3%	11.41	Watch for copper lockup
Active Carbon		0.00	0
Min required OM for structural integrity	3		

CROSS 0.83 <0.5

Anions

		Index	Found kg/ha	Target kg/ha	(+or-)	Treatment
Olsen P	Phosphate (P2O5)	3	185	112	73.2	Maintain P levels
		0		0	0.00	
	Sulphate (So3) below detectable levels		110.7	78	32.7	

Trace Elements PPM

Availabile trace elements to roots			Guide range			Soil Treatments	Foliar treatment
Hot water	Boron (B)	mg/l	1.2	to 2.4	1.0	Apply Granular Boron	High Boron demanding crops only
M3	Iron (Fe)	mg/l	19	to 189	410	Apply products that create new roots	0
M3	Manganese (Mn)	mg/l	18	to 70	65		
M3	Copper (Cu)	mg/l	2.5	to 7	2.6	Consider maintenance levels of copper.	
M3	Zinc (Zn)	mg/l	4	to 10	4.5	.	
	Chloride (Cl)	mg/l	20	to 50	0.9		0
Hot water	Iodine (I)	mg/l	1	to 1	0		0
M3	Molybdenum (M	mg/l	0.5	to 0.5	N/A	N/A	
M3	Cobalt (Co)	mg/l	0.5	to 2	0.33		0

RB209

mg/l		UK Index	RB209 av: yield crop recommendations			Advisor Comments
41.4	Phosphate	3	kg/ha	0	0	
					off take	
257.71	Potash	3	kg/ha	0	0	
2.0	K:Mg Ratio OK					
125.92	Magnesium	3	kg/ha	0		

No guidance available for this crop, or no P,K required

SOIL ANALYSIS REPORT

Laboratory Sample Reference	Field Details			Index			mg/l (Available)		
	No.	Name or O.S. Reference with Cropping Details	Soil pH	P	K	Mg	P	K	Mg
75444/19	1	**3385** *No cropping details given*	**5.9**	**2**	**1**	**3**	**21.2**	**76**	**149**
75445/19	2	**7973** *No cropping details given*	**5.8**	**0**	**0**	**2**	**6.8**	**59**	**91**
75446/19	3	**5455** *No cropping details given*	**5.8**	**1**	**1**	**3**	**12.4**	**77**	**120**
75447/19	4	**6198** *No cropping details given*	**5.7**	**1**	**2-**	**3**	**10.2**	**173**	**127**
75448/19	5	**0999** *No cropping details given*	**5.9**	**0**	**1**	**3**	**9.2**	**120**	**159**
75449/19	6	**4617** *No cropping details given*	**5.9**	**2**	**1**	**3**	**16.2**	**63**	**116**

If general fertiliser and lime recommendations have been requested, these are given on the following sheets.
The analytical methods used are as described in DEFRA Reference Book 427
The index values are determined from the DEFRA Fertiliser Recommendations RB209 9th Edition.

Reference: **17747/75444/19** Field Name: **3385**	**Result**	**(*)**	**Deficient**	**Marginal**	**Target**	**Marginal**	**Excessive**
Copper (EDTA Extractable) mg/l	10.0						
Boron (Hot Water Soluble) mg/l	1.3						
Sodium (Ammonium Nitrate Extractable) mg/l	31.0	1					
Zinc (EDTA Extractable) mg/l	13.3	2					
Calcium (Ammonium Nitrate Extractable) mg/l	1995.5						
Iron (DTPA Extractable) mg/l	381.8	3					
Organic matter (LOI) %	11.2	4	*OM level data not available for this crop*				
Sulphate (Phosphate Buffer Extractable) mg/l	66.6	5					
Manganese (DTPA Extractable) mg/l	12.2	6					
Estimated Cation Exchange Capacity meq/100g	19.1	7					

Reference: **17747/75445/19** Field Name: **7973**	**Result**	**(*)**	**Deficient**	**Marginal**	**Target**	**Marginal**	**Excessive**
Copper (EDTA Extractable) mg/l	5.9						
Boron (Hot Water Soluble) mg/l	1.4						
Sodium (Ammonium Nitrate Extractable) mg/l	13.2	1					
Zinc (EDTA Extractable) mg/l	5.7						
Calcium (Ammonium Nitrate Extractable) mg/l	2016.5	8					
Iron (DTPA Extractable) mg/l	265.7	3					
Organic matter (LOI) %	10.4	4	*OM level data not available for this crop*				
Sulphate (Phosphate Buffer Extractable) mg/l	25.1	5					
Manganese (DTPA Extractable) mg/l	11.0						
Estimated Cation Exchange Capacity meq/100g	18.7	7					

Reference: **17747/75446/19** Field Name: **5455**	**Result**	**(*)**	**Deficient**	**Marginal**	**Target**	**Marginal**	**Excessive**
Copper (EDTA Extractable) mg/l	9.4						
Boron (Hot Water Soluble) mg/l	1.0						
Sodium (Ammonium Nitrate Extractable) mg/l	19.1	1					
Zinc (EDTA Extractable) mg/l	10.5	2					
Calcium (Ammonium Nitrate Extractable) mg/l	1767.2						
Iron (DTPA Extractable) mg/l	383.2	3					
Organic matter (LOI) %	10.4	4	*OM level data not available for this crop*				
Sulphate (Phosphate Buffer Extractable) mg/l	24.9	5					
Manganese (DTPA Extractable) mg/l	10.4						
Estimated Cation Exchange Capacity meq/100g	17.6	7					

Reference: **17747/75447/19** Field Name: **6198**	**Result**	**(*)**	**Deficient**	**Marginal**	**Target**	**Marginal**	**Excessive**
Copper (EDTA Extractable) mg/l	5.1						
Boron (Hot Water Soluble) mg/l	1.3						
Sodium (Ammonium Nitrate Extractable) mg/l	27.0	1					
Zinc (EDTA Extractable) mg/l	10.7	2					
Calcium (Ammonium Nitrate Extractable) mg/l	1725.2						
Iron (DTPA Extractable) mg/l	321.5	3					

Soil Report

UKAS TESTING
7624

D & E Young
Drum Farm
Kilkenzie
CAMPBELTOWN
Argyll
Argyll
PA28 6QD

SAC COMMERCIAL LTD

Farm Sampled	Drum	**Previous Crop**	Winter barley	**Batch Number**	S3361
Field Name or ID	WB1	**Next Crop**	Winter barley	**Lab Sample No**	19006207
FID Number	NR/66133/24984	**Date received**	31/07/2019	**Case No**	ASD-2019-4025
Soil Type	Mineral	**Date reported**	28/08/2019 14:34:3		

Determination	Result	Units	Target Value	Target Status	Status
pH	5.1				5.0 … 7.0; 5.1; Very Low / Low / Moderate - / Moderate + / High / Very High
Extractable Phosphorus	18.4	mg/l	4.5-9.4	M-	
Extractable Potassium	60.20	mg/l	76-140	M-	Very Low / Low / Moderate / High / Very High
Extractable Magnesium	34.30	mg/l	61-200	M	
* Extractable Manganese	7.5	mg/l	2.6-20	M	
Extractable Zinc	4.1	mg/l	1.6-10	M	Very Low / Low / Moderate / High
Extractable Cobalt	0.15	mg/l	0.66-0.94	M	Low / Moderate / High
Aqua Regia Selenium	0.137	mg/kg	0.3-0.6 (**)	M	
Extractable Calcium	390	mg/l	1000-3000 (**)	M	0 … 50; 7.390
Extractable Sodium	7.390	mg/l			
Lime req (Arable)	8.0	t/ha			
Lime req (Grass)	5.5	t/ha			

SLURRY/SLUDGE ANALYSIS RESULTS (Metric Units)

Sample Reference : SPRING 2018

Sample Matrix : SLURRY/SLUDGE

The sample submitted was of adequate size to complete all analysis requested.

The sample will be kept under refrigeration for at least 3 weeks.

Laboratory References	
Report Number	13395
Sample Number	68384

Date Received	18-MAY-2018
Date Reported	23-MAY-2018

ANALYTICAL RESULTS *on 'as received' basis.*

Determinand on a fresh weight basis	Units	Result	Amount per fresh tonne or m3	Amount applied at an equivalent total Nitrogen application of 250 kg N/ha	Units
pH 1:6 [Fresh]		7.80			
Oven Dry Solids	%	4.12	41.20	4905	kg DM
Total Nitrogen	% w/w	0.210	2.10	250	kg N
Ammonium Nitrogen	mg/kg	1213	1.21	144.41	kg NH4-N
Nitrate Nitrogen	mg/kg	<10	< 0.01		kg NO3-N
Total Phosphorus (P)	mg/kg	368	0.84	100.33	kg P2O5
Total Potassium (K)	mg/kg	2696	3.24	385.15	kg K2O
Total Magnesium (Mg)	mg/kg	409	0.68	80.83	kg MgO
Total Sulphur (S)	mg/kg	275	0.69	81.85	kg SO3
Total Copper (Cu)	mg/kg	8.05	0.01	0.96	kg Cu
Total Zinc (Zn)	mg/kg	11.8	0.01	1.40	kg Zn
Total Sodium (Na)	mg/kg	593	0.80	95.16	kg Na2O
Total Calcium (Ca)	mg/kg	1015	1.01	120.84	kg Ca
Equivalent field application rate		——	1.00	119.05	tonnes or m3 / ha

The above equivalent field application rate for total nitrogen of 250 kg/ha has been provided purely for guidance purposes only. Organic manures should be used in accordance with the Defra Code of Good Agricultural Practice and where required within the specific regulatory guidance for the spreading of that material to land. To get the most benefit from your organic manures it is recommended that you follow the principles as set out in Defra's Fertiliser Manual (RB209) or as directed by a FACTS qualified adviser.

Released by J Doyle Date 23/05/18

SLURRY (Metric Units)

Sample Reference : 56/526/0057

Sample Matrix : SLURRY

The sample submitted was of adequate size to complete all analysis requested.

The sample will be kept under refrigeration for at least 3 weeks.

Laboratory References	
Report Number	14854
Sample Number	68972

Date Received	01-JUN-2018
Date Reported	11-JUN-2018

ANALYTICAL RESULTS *on 'as received' basis.*

Determinand on a fresh weight basis	Units	Result	Amount per fresh tonne or m3	Amount applied at an equivalent total Nitrogen application of 250 kg N/ha	Units
pH 1:6 [Fresh]		6.88			
Oven Dry Solids	%	11.7	117.00	6964	kg DM
Total Nitrogen	% w/w	0.420	4.20	250	kg N
Ammonium Nitrogen	mg/kg	1716	1.72	102.14	kg NH4-N
Nitrate Nitrogen	mg/kg	<10	< 0.01		kg NO3-N
Total Phosphorus (P)	mg/kg	584	1.34	79.60	kg P2O5
Total Potassium (K)	mg/kg	2735	3.28	195.34	kg K2O
Total Magnesium (Mg)	mg/kg	611	1.01	60.37	kg MgO
Total Sulphur (S)	mg/kg	526	1.32	78.27	kg SO3
Total Copper (Cu)	mg/kg	7.14	0.01	0.42	kg Cu
Total Zinc (Zn)	mg/kg	18.9	0.02	1.12	kg Zn
Total Sodium (Na)	mg/kg	632	0.85	50.71	kg Na2O
Total Calcium (Ca)	mg/kg	5671	5.67	337.54	kg Ca
Equivalent field application rate		——	1.00	59.52	tonnes or m3 / ha

The above equivalent field application rate for total nitrogen of 250 kg/ha has been provided purely for guidance purposes only. Organic manures should be used in accordance with the Defra Code of Good Agricultural Practice and where required within the specific regulatory guidance for the spreading of that material to land. To get the most benefit from your organic manures it is recommended that you follow the principles as set out in Defra's Fertiliser Manual (RB209) or as directed by a FACTS qualified adviser.

Released by *Darren Whitbread* Date *11/06/18*

Lab ID: 52936 - 81702
Sample ID: 170419 WD
Sample Type: Whole Digestate

Date Received: 23/04/2019
Date Reported: 01/05/2019
Date Sampled: 17/04/2019

Characteristics of WD / SL / SF for declaration, without limit values, that influence application rates
(Results on an 'as received' basis)

Parameter	Units	Result	M *	Amount per fresh tonne or m^3	Amount applied at an equivalent total Nitrogen application of 250 kg N/ha	Units
pH		8.2	1			
Oven Dry Matter	% m/m	4.33	2	43.30	1899	Kg DM
Loss On Ignition	% m/m	3.06	3	30.60	1342	Kg OM
Total Nitrogen (N)	% m/m	0.57	4	5.70	250	Kg N
Ammoniacal Nitrogen (NH4-N)	mg/kg	3787	5	3.79	166.10	Kg NH4-N
Total Phosphorus (P)	mg/kg	1030	6	2.36	103.45	Kg P2O5
Total Potassium (K)	mg/kg	1573	6	1.89	82.79	Kg K2O
Total Magnesium (Mg)	mg/kg	130	6	0.22	9.46	Kg MgO
Total Sulphur (S)	mg/kg	447	6	1.12	49.01	Kg SO3
Equivalent field application rate		—		1.00	43.86	tonnes or m^3 / ha

*** Method of Test**

1 BS EN 13037
2 BS EN 14346
3 BS EN 15169
4 BS EN 13654-1 (Kjeldahl)
5 Sciantec SOP S1162 (Kjeldahl)
6 BS EN 15587 (soluble in aqua regia)

SOILS

How does your sample analysis compare with the 'standard' figures for organic manures?

Farmyard Manure	Dry Matter (% DM)	Total Nitrogen (Kg N/t)	Total Phosphate (Kg P2O5/t)	Total Potash (Kg K2O/t)	Total Sulphur (Kg SO3/t)	Total Magnesium (Kg MgO/t)
Cattle FYM	25	6.0	3.2	9.4	2.4	1.8
Pig FYM	25	7.0	6.0	8.0	3.4	1.8
Sheep FYM	25	7.0	3.2	8.0	4.0	2.8
Duck FYM	25	6.5	5.5	7.5	2.6	2.4
Horse FYM	25	5.0	5.0	6.0	1.6	1.5
Goat FYM	40	9.5	4.5	12.0	2.8	1.8

Notes: The 'standard' phosphate & potash availability figures to the next crop grown from Defra's Fertiliser Manual are 60% & 90% respectively.

Poultry Manure	Dry Matter (% DM)	Total Nitrogen (Kg N/t)	Total Phosphate (Kg P2O5/t)	Total Potash (Kg K2O/t)	Total Sulphur (Kg SO3/t)	Total Magnesium (Kg MgO/t)
	20	9.4	8.0	8.5	3.0	2.7
	40	19.0	12.0	15.0	5.6	4.3
	60	28.0	17.0	21.0	8.2	5.9
	80	37.0	21.0	27.0	11.0	7.5

Notes: The 'standard' phosphate & potash availability figures to the next crop grown from Defra's Fertiliser Manual are 60% & 90% respectively.

Cattle & Pig Slurries	Dry Matter (% DM)	Total Nitrogen (Kg N/m3)	Total Phosphate (Kg P2O5/m3)	Total Potash (Kg K2O/m3)	Total Sulphur (Kg SO3/m3)	Total Magnesium (Kg MgO/m3)
Cattle slurry	6.0	2.6	1.2	2.5	0.7	0.6
Dirty water (from cattle)	0.5	0.5	0.1	1.0	0.1	0.1
Separated cattle slurries						
- strainer box liquid	1.5	1.5	0.3	1.5	ND	ND
- weeping wall liquid	3.0	2.0	0.5	2.3	ND	ND
- mechanically separated liquid	4.0	3.0	1.2	2.8	ND	ND
- solid portion after separation	20.0	4.0	2.0	3.3	ND	ND
Pig slurry	4.0	3.6	1.5	2.2	0.7	0.7
Separated pig slurry - liquid	3.0	3.6	1.1	2.0	ND	ND
Separated pig slurry - solid	20.0	5.0	3.7	2.0	ND	ND

Notes: ND = no data.
The 'standard' phosphate & potash availability figures to the next crop grown from Defra's Fertiliser Manual are 50% & 90% respectively (50% & 100% for dirty water).

Biosolids	Dry Matter (% DM)	Total Nitrogen (Kg N/t)	Total Phosphate (Kg P2O5/t)	Total Potash (Kg K2O/t)	Total Sulphur (Kg SO3/t)	Total Magnesium (Kg MgO/t)
Digested cake	25	11.0	11.0	0.6	8.2	1.6
Thermally dried	95	40.0	55.0	2.0	23.0	6.0
Lime stablised	25	8.5	7.0	0.8	7.4	2.4
Composted	40	11.0	10.0	3.0	6.1	2.0

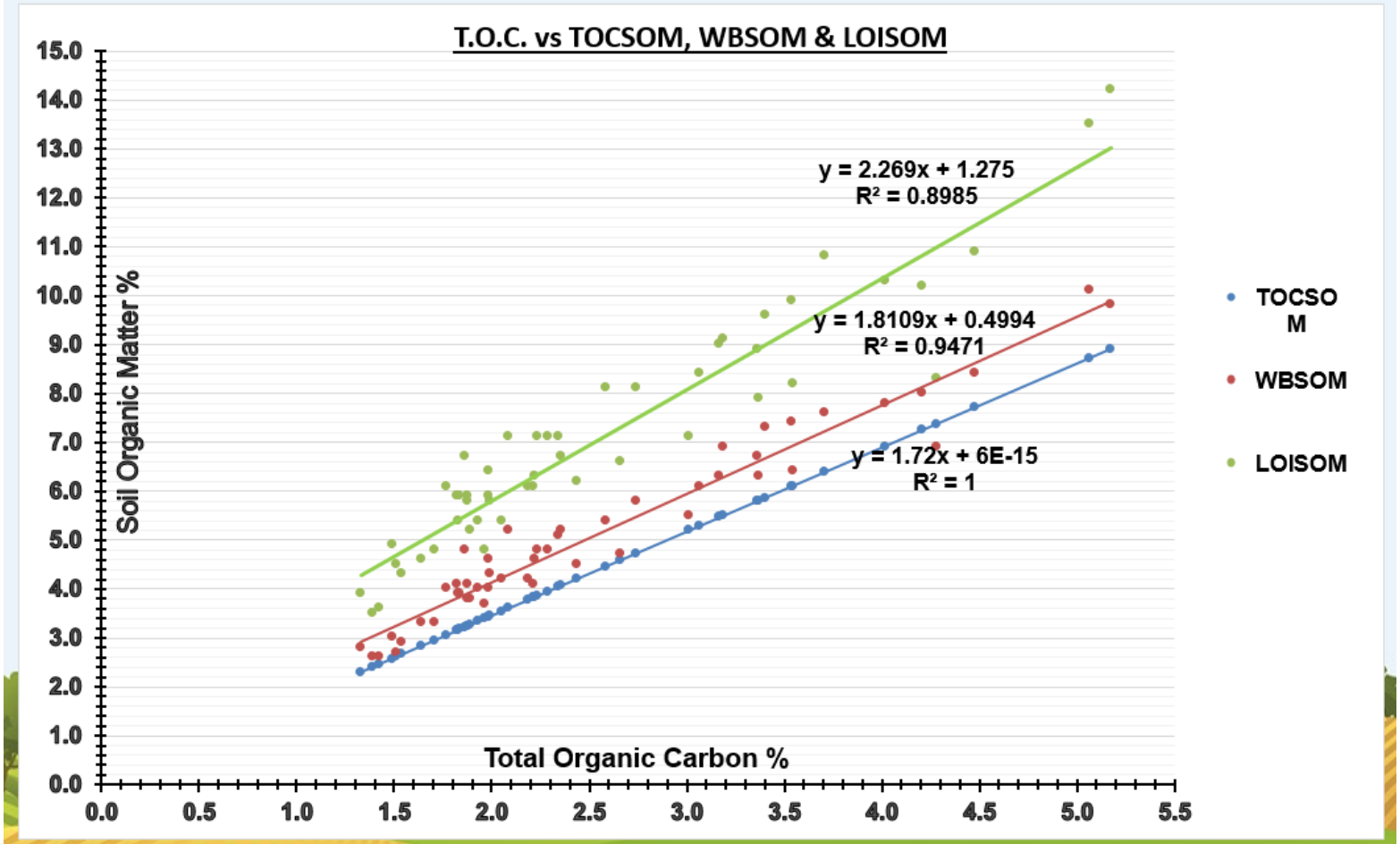
Notes: The 'standard' phosphate & potash availability figures to the next crop grown from Defra's Fertiliser Manual are 50% & 90% respectively.

Other Organic Manures	Dry Matter	Total Nitrogen	Total Phosphate	Total Potash	Total Sulphur	Total Magnesium
Composts	(% DM)	(Kg N/t)	(Kg P2O5/t)	(Kg K2O/t)	(Kg SO3/t)	(Kg MgO/t)
Green compost	60	7.5	3.0	6.8	3.4	3.4
Green/food compost	60	11.0	4.9	8.0	5.1	3.4
Mushroom compost	35	6.0	5.0	9.0	ND	ND
Digestates						
Food-based whole	4.1	4.8	1.1	2.4	0.7	0.2
Food-based separated liquor	3.8	4.5	1.0	2.8	1.0	0.2
Food-based separated fibre	27.0	8.9	10.2	3.0	4.0	2.2
Farm-sourced whole	5.5	3.6	1.7	4.0	0.8	0.6
Farm-sourced separated liquor	3.0	1.9	0.6	2.5	<0.1	0.4
Farm-sourced separated fibre	24.0	5.6	4.7	6.0	1.2	1.8
Paper Crumble						
Chemically / physically treated	40	2.0	0.4	0.2	0.6	1.4
Biologically treated	30	7.5	3.8	0.4	2.4	1.0
Water Treatment Cake						
Water treatment cake	25	2.4	3.4	0.4	5.5	0.8
Food industry 'wastes'	(% DM)	(Kg N/m3)	(Kg P2O5/m3)	(Kg K2O/m3)	(Kg SO3/m3)	(Kg MgO/m3)
Dairy waste	4	1.0	0.8	0.2	ND	ND
Soft drinks waste	4	0.3	0.2	Trace	ND	ND
Brewing waste	7	2.0	0.8	0.2	ND	ND
General food waste	5	1.6	0.7	0.2	ND	ND

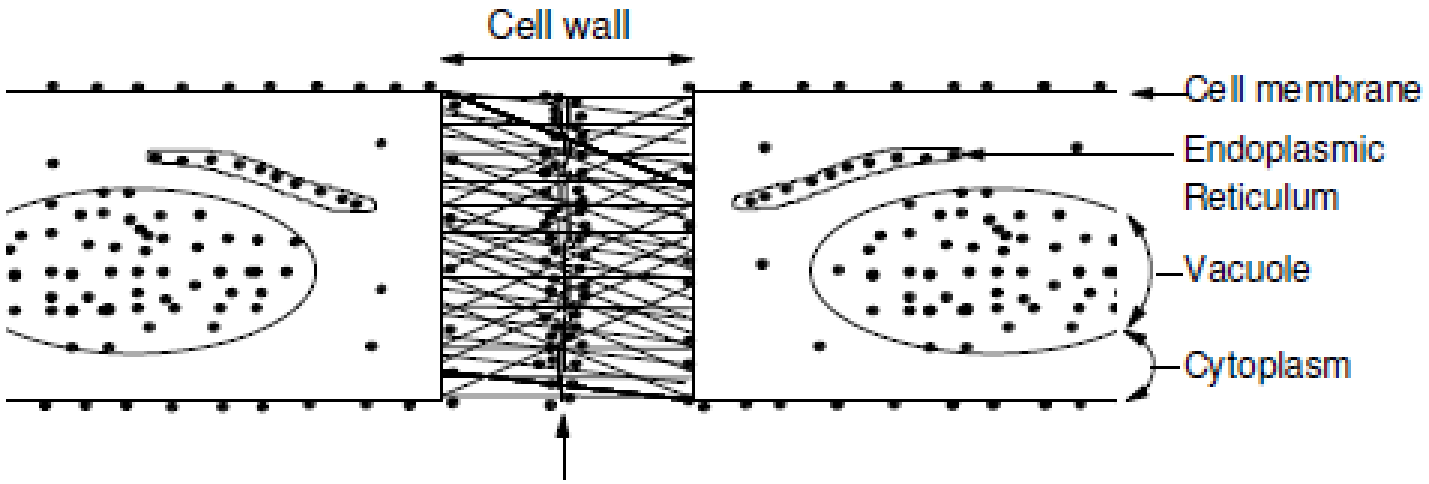
Notes: ND = no data.

The 'standard' figures for the above organic manures have been taken from Defra's Fertiliser Manual 2017 (RB209) 9th edition and the corresponding PLANET version 3 software. Further information on fertiliser recommendations for organic manures can be obtained from the Fertiliser Manual or from a FACTS qualified adviser.

Soil Health Package

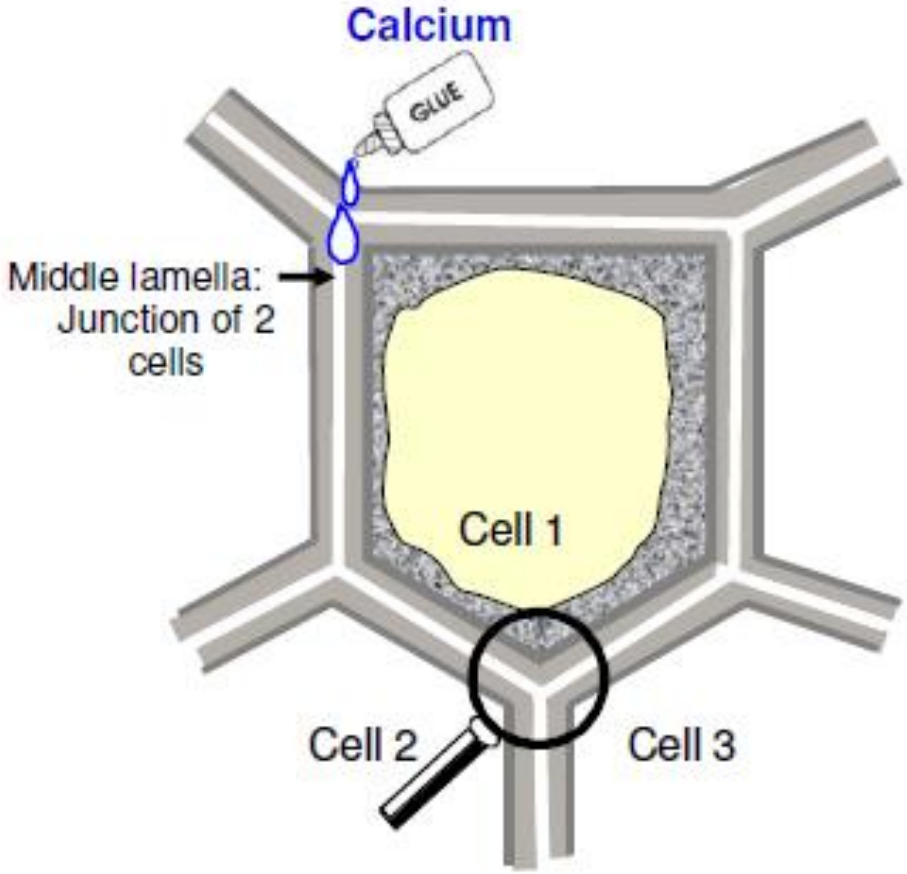


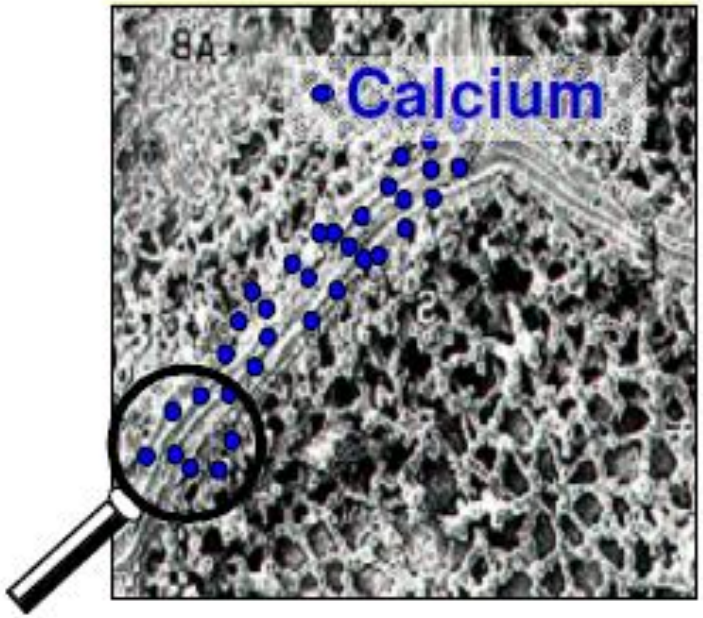
Up to 90% of the total cell Ca is in cell walls.
Ca deficiency results in cell disintegration



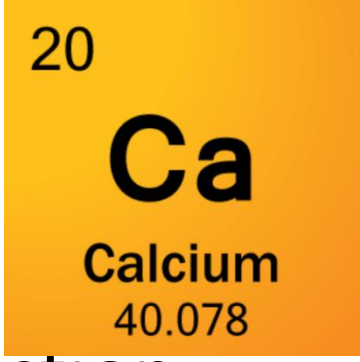
REF: adapted from Marschner (1995)

In the middle lamella, Calcium is binding the cells together - like a glue



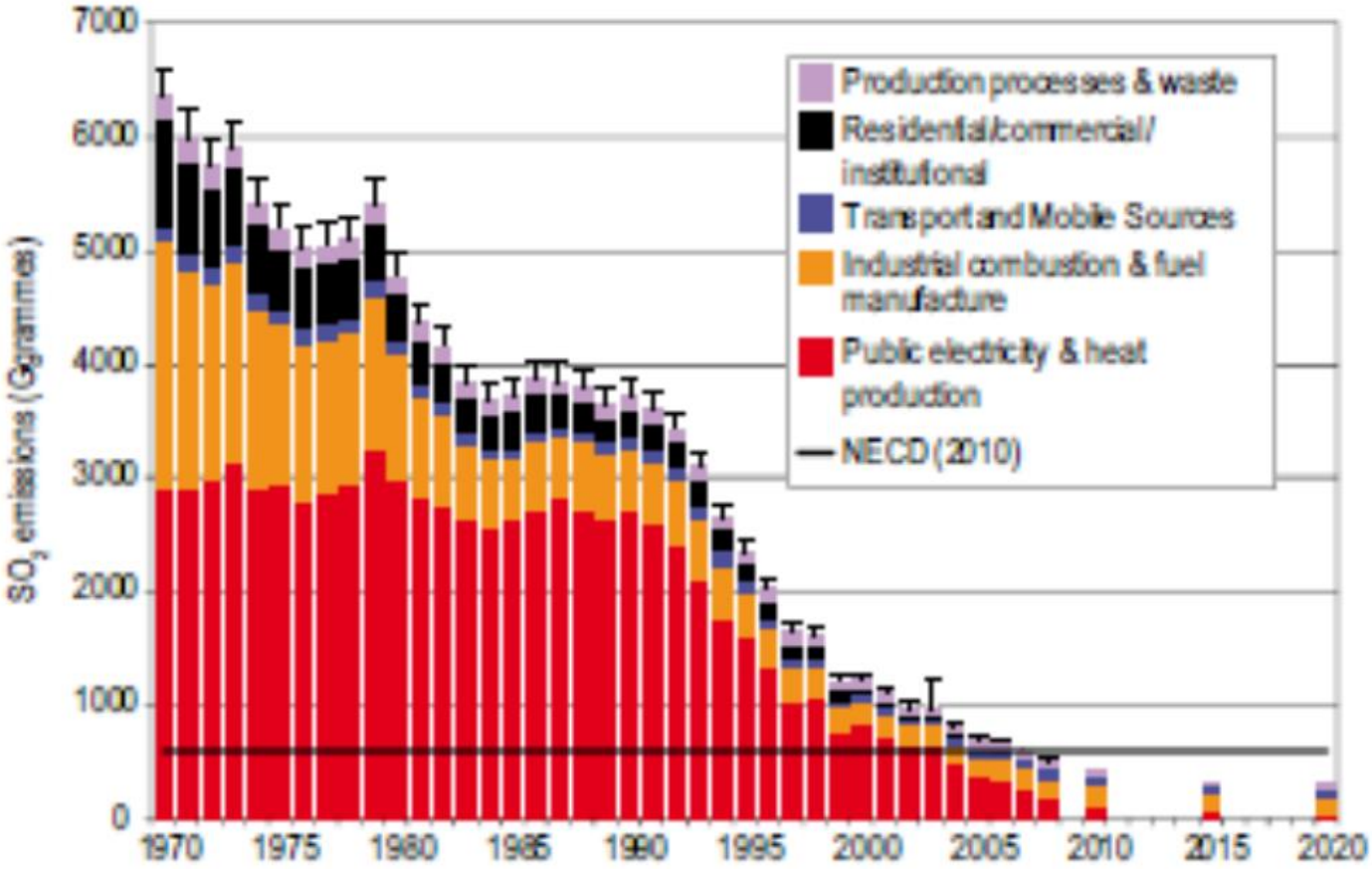


Calcium

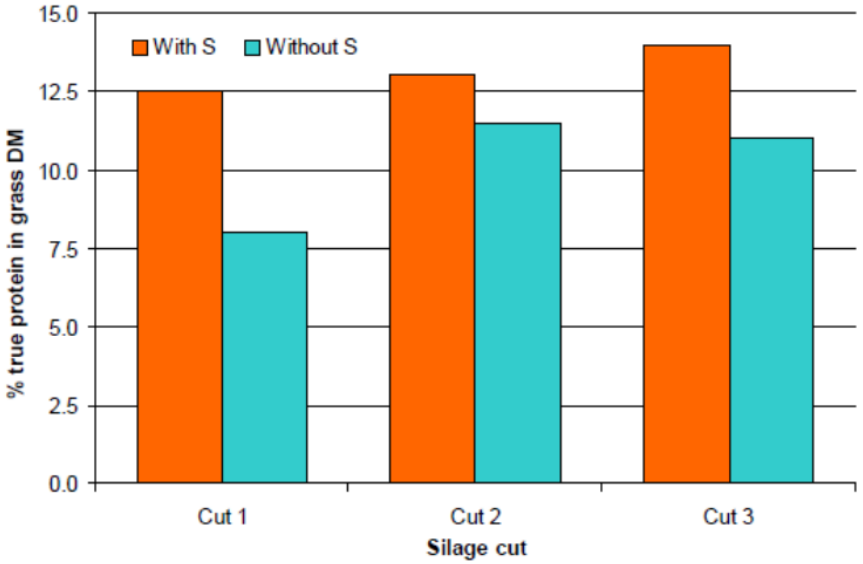


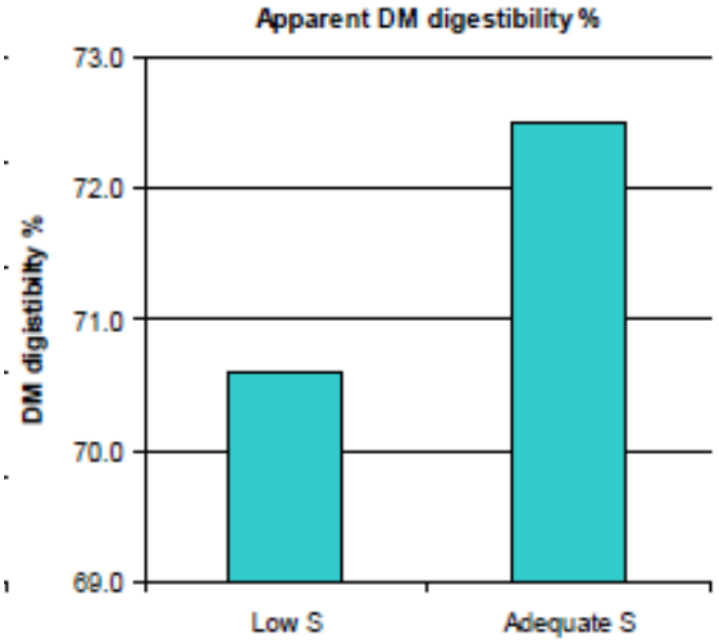
- Essential constituent in Cell wall construction
- Strengthens plants physical structure helping
  - -protect against insect & disease attack
  - -more efficient use of sunlight
  - -more efficient use of nutrients
- Reduces soil compaction by improving soil structure
- Adjusts/maintains soil pH

Sulphur Emissions



Sulphur Benefits





Higher Yield
Higher Protein Content
Improved Digestibility (Higher WSC)
Improved Selenium assimilation in the Rumen

Calcium has been described as the Trucker of nutrients & Boron the Steering wheel. One without the other does not work as well.

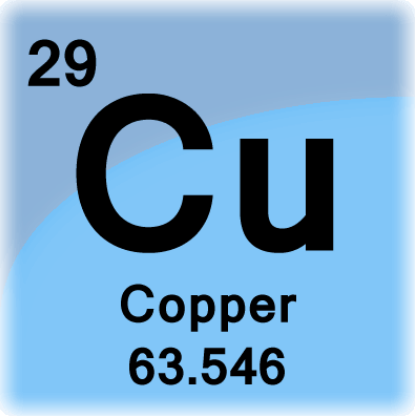
Boron

- Seed Development
- Promotes Flowering & Pollen Production
- Root & Leaf Growth
- Cell Wall Formation
- Protein Production
- Sugar Translocation
- Energy release in cells
- Increased Calcium Uptake
- Improved Crop Quality

Zinc

- Activating plant Enzymes- spur growth and plant development
- Prevents small leaf- which results in poor yield & quality
- Promotes cell development
- Increases plants ability to absorb Calcium
- Direct correlation to Yield & Quality
- Promotes early development of produce
- Essential role in pollination & seed development

Copper



Symptom description

- Ears of Cu deficient plants are often trapped in the sheath and emerge with white tips and blind spikelet's. Plants show dry, white and twisted or curled leaf tips (white tip). Young leaves wilt on their tips, whereas the basal leaves remain dark green.

Made worse by

- Organic soils. Chalky soils. Sandy soils. Reclaimed heathland. High nitrogen applications, high soil phosphate

Important for

- Increased fertility (number of grains per ear). Better grain quality.
- Manufacture of Lignin for cell walls

Cause description

- Copper deficiency Severe drought, heavy frosts and herbicide damage can cause blind ears, too.

Role of Nutrients in Potatoes

	Tuber Size	Tuber Number	Tuber Quality	Skin Finish	Storage Quality
N	+		+		
P	+	+	+		
K	+	+	+		+
Ca			+	+	+
Mg	+		+	+	
S				+	
Mn	+		+	+	
B	+		+	+	+
Zn			+	+	

Other Nutrient Effects

- Nitrogen inhibits Copper
- Nitrogen & Sulphur can inhibit Selenium
- High Phosphorus depresses calcium & magnesium absorption
- High Magnesium depresses phosphorus absorption
- High soil Magnesium depresses Potash uptake and causes soil structure issues
- High Iron cause Mn, Cu, Zn & Co deficiencies.

More Nutrient Interactions

- High levels of Potash depress magnesium in the animal (subclinical staggers). Causing bitter pastures (add salt)
- High Phosphate depresses Cu & Zn availability
- Anaerobic soils make Molybdenum more available depressing Cu availability
- Low Calcium in the soil creates poor structure low availability and poor digestible fibre in grass

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