Understanding your soil analysis
Bryan McLeod

UNDERSTANDING YOUR SOILS USING THE ALBRECHT MODEL

BRYAN MCLEOD














Why Analyse our soils

- IF YOU CAN'T TEST IT YOU CAN'T GUESS IT
- Understanding our soils limiting factors helps us to build a strong foundation and a good environment for all beneficial soil biology
- We can wait and let it happen or help make it happen
- We need to understand our soils positives and negatives
- Working with our soils, we can help them develop, structurally and biologically, seeing the beneficial end results is extremely rewarding
- As we grow plants soil nutrient levels change, eg all plants as they grow acidify the soil – they take in H_2O, the H goes to the soil

Soils Mineral Balance has a direct effect on the following.

- **PERCENTAGE OF CROP WASTAGE AT HARVEST**
- **PLANT NUTRITIONAL CONTENT.** Directly related to soil mineral balance
- **FLAVOUR/PALATABILITY .** Directly related to soil mineral balance
- **SHELF LIFE .** Directly related to soil mineral balance

A soil analysis has to be

EDUCATIONAL teaching you to understand your soil

PROVIDING INFORMATION & ASSISTANCE
for you to be able to formulate the correct fertiliser program for your particular soil.

Don’t look over the fence your soil is unique to you

ALLOWS YOU TO TEST THE SOIL TESTER

UNDERSTANDING THE THREE ASPECTS of YOUR SOIL

CHEMICAL ↔ **PHYSICAL**

BIOLOGICAL

If air space is increased by altering the chemical balance → increased microbial activity → improved soil structure → more natural N → more available P

Do we want to grow volume or volume and quality
Look for all limiting factors

Having a good looking plant doesn’t automatically mean its nutritious

Being organic doesn’t automatically mean its good

Quality means nutrition, taste and shelve life

Not only volume

Sulphur is the limiting factor

Poor soil structure due to –

28% Exchangeable Sodium ideal 0.5 to 3%. Lime applied and worked to 50mm – result 12 months later

Compacted High 8.4 PH - Excess Mg 40% – low Ca 40%.

Lime applications displacing Mg

Now 62%Ca, Mg 18%

DIAGNOSING NUTRIENT DEFICIENCIES BY PLANT ANALYSIS

(Robin Graham - Waite Analytical Services)

- Table 1. **The concentrations of nutrients in young leaf-petiole tissue of two broad-acre crops growing across the fence from each other, one of them giving the farmer cause for concern because of lack of vigour and an unusual pale yellow colour.**

	Concentrations of nutrients in tissue (mg/kg)				
Crop condition	Nitrate-N	P	K	S	Zn
Vigorous	2,500	2,100	32,000	1,900	21
Poor	9,000	3,000	38,000	160	29


Sampling tool
Strong plastic bag or clean plastic bucket
Placing sample in clean plastic bag.
Push probe into full depth (150mm) cultivated soil. 100 mm pasture or “no till” cropping
Compress cultivated soil with heel. Then sample in heel print
Take at least 20 plugs from a given area per sample

Presentation of data comes in many different forms from each Lab

But they can all contain the same info, we just need to know how to extract it.

We will see how

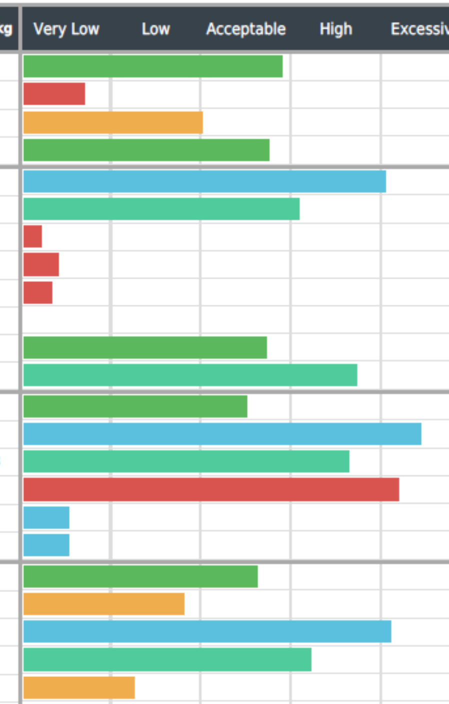
So often when we receive our long awaited soil reports

At first glance the data can be a little confronting –

All labs data contains valuable info it may be just in a different format. Some is easier to understand

Lab No		XSS20092	XSS20093	XSS
Name		[illegible]	[illegible]	[illegible]
Code		07/07/20	07/07/20	07/0
Customer		[illegible]	[illegible]	[illegible]
Depth		0-10	0-10	0-
Colour		[illegible]	DKGR	G
Gravel	%	[illegible]	[illegible]	[illegible]
Texture		2.5	2.5	3
Ammonium Nitrogen	mg/kg	[illegible]	[illegible]	[illegible]
Nitrate Nitrogen	mg/kg	22	39	6
Phosphorus Colwell	mg/kg	203	318	[illegible]
Potassium Colwell	mg/kg	705	1125	25
Sulfur	mg/kg	19.1	14.1	10.
Organic Carbon	%	[illegible]	[illegible]	[illegible]
Conductivity	dS/m	0.130	0.183	0.0
pH Level (CaCl2)		[illegible]	[illegible]	[illegible]
pH Level (H2O)		6.8	5.5	6.4
DTPA Copper	mg/kg	[illegible]	[illegible]	1.3
DTPA Iron	mg/kg	437.60	467.00	312.
DTPA Manganese	mg/kg			
DTPA Zinc	mg/kg			
Exc. Aluminium	meq/100g			
Exc. Calcium	meq/100g			
Exc. Magnesium	meq/100g			
Exc. Potassium	meq/100g			

		Unit	Desired Level	Level Found	c.mol/kg
Extractable N,P,K,S	ECEC	cmol/kg	5.00-25.0	22.6	
	Organic Carbon (W&B)	%	1.20-2.00	0.540	
	pH 1:5 water	pH units	6.50-7.50	6.48	
	pH CaCl2 (following 4A1)	pH units	5.50-6.50	6.23	
	Nitrate - N (2M KCl)	mg/kg	20-50	160	
	Ammonium - N (2M KCl)	mg/kg	2.0-10	12	
	Olsen Phosphorus	mg/kg	15-25	1.9	
	Colwell Phosphorus	mg/kg	[illegible]	5.0	
	Bray 2 Phosphorus	mg/kg	30-60	6.0	
	DGT-P	µg/L		13.0	
	PBI Unadjusted		35.0-70.0	60.0	
	MCP Sulfur (S)	mg/kg	8.0-20	41	
Exchangeable cations	Calcium (Ca) - AmmAc	mg/kg	[illegible]-2500	1830	9.14
	Magnesium (Mg) - AmmAc	mg/kg	[illegible]-350	850	6.99
	Potassium (K) - AmmAc	mg/kg	150-220	363	0.928
	Sodium (Na) - AmmAc	mg/kg	[illegible]-160	1260	5.50
	Exchangeable aluminium	cmol/kg	[illegible]-0.35	<0.02	
	Exchangeable hydrogen	cmol/kg	0.10-0.35	<0.02	
Trace Elements	Boron	mg/kg	0.50-2.0	1.4	
	Iron (Fe)	mg/kg	10-70	8.9	
	Manganese (Mn)	mg/kg	1.0-10	93	
	Copper (Cu)	mg/kg	0.50-1.0	1.8	
	Zinc (Zn)	mg/kg	0.50-1.0	0.19	



Environmental Analysis Laboratory

Southern Cross Univer
PO Box 157 Lismore NS
P: +61 2 6620 3678
E: eal@scu.edu.au
www.scu.edu.au/eal
ABN: 41 995 651 524

AGRICULTURAL SOIL ANALYSIS REPORT

1 sample supplied by FarmLab on 12/11/2020. Lab Job No.K0574
Analysis requested by Sam Duncan. Your Job: Ray Milidoni - FL0000218
Level 2, W40 ARMIDALE NSW 2351

		Sample 1	Heavy Soil	Medium Soil	Light Soil	Sandy Soil
	Sample ID:	FL0000218				
	Crop:	Soil				
	Client:	Ray Milidoni	Clay	Clay Loam	Loam	Loamy Sand
Parameter	Method reference	K0574/1	Indicative guidelines - refer to Notes 6 and 8			
Soluble Calcium (mg/kg)	**Inhouse S10 - Morgan 1	5,574	1150	750	375	175
Soluble Magnesium (mg/kg)		601	160	105	60	25
Soluble Potassium (mg/kg)		723	113	75	60	50
Soluble Phosphorus (mg/kg)		314	15	12	10	5.0
Phosphorus (mg/kg P)	**Rayment & Lyons 2011 - 9E2 (Bray 1)	295	45 [note 8]	30 [note 8]	24 [note 8]	20 [note 8]
	**Rayment & Lyons 2011 - 9B2 (Colwell)	859	80	50	45	35
	**Inhouse S3A (Bray 2)	1,292	90 [note 8]	60 [note 8]	48 [note 8]	40 [note 8]
Nitrate Nitrogen (mg/kg N)	**Inhouse S37 (KCl)	120	15	13	10	10
Ammonium Nitrogen (mg/kg N)		11	20	18	15	12
Sulfur (mg/kg S)		66	10.0	8.0	8.0	7.0
pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	7.32	6.5	6.5	6.3	6.3
Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.516	0.200	0.150	0.120	0.100
Estimated Organic Matter (% OM)	**Calculation: Total Carbon x 1.75	16	> 5.5	>4.5	> 3.5	> 2.5

EAL Lab uses Albrecht calculations

I use the APAL lab, one of my consultant clients uses CSBP

Environmental Analysis Laboratory

Southern Cross Univer[sity]
PO Box 157 Lismore NS[W]
P: +61 2 6620 3678
E: eal@scu.edu.au
www.scu.edu.au/eal
ABN: 41 995 651 524

Today we will look at two sets of data. Rays Dad's Garden and Megan's pasture

AGRICULTURAL SOIL ANALYSIS REPORT

1 sample supplied by FarmLab on 12/11/2020. Lab Job No.K0574
Analysis requested by Sam Duncan. Your Job: Ray Milidoni - FL0000218
Level 2, W40 ARMIDALE NSW 2351

Parameter		Method reference	Sample 1	Heavy Soil	Medium Soil	Light Soil	Sandy Soil
		Sample ID:	FL0000218				
		Crop:	Soil				
		Client:	Ray Milidoni	Clay	Clay Loam	Loam	Loamy Sand
Parameter		Method reference	K0574/1	Indicative guidelines - refer to Notes 6 and 8			
Soluble Calcium (mg/kg)		**Inhouse S10 - Morgan 1	5,574	1150	750	375	175
Soluble Magnesium (mg/kg)			601	160	105	60	25
Soluble Potassium (mg/kg)			723	113	75	60	50
Soluble Phosphorus (mg/kg)			314	15	12	10	5.0
Phosphorus (mg/kg P)		**Rayment & Lyons 2011 - 9E2 (Bray 1)	295	45 note 8	30 note 8	24 note 8	20 note 8
		**Rayment & Lyons 2011 - 9B2 (Colwell)	859	80	50	45	35
		**Inhouse S3A (Bray 2)	1,292	90 note 8	60 note 8	48 note 8	40 note 8
Nitrate Nitrogen (mg/kg N)		**Inhouse S37 (KCl)	120	15	13	10	10
Ammonium Nitrogen (mg/kg N)			11	20	18	15	12
Sulfur (mg/kg S)			66	10.0	8.0	8.0	7.0
pH		Rayment & Lyons 2011 - 4A1 (1:5 Water)	7.32	6.5	6.5	6.3	6.3
Electrical Conductivity (dS/m)		Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.516	0.200	0.150	0.120	0.100
Estimated Organic Matter (% OM)		**Calculation: Total Carbon x 1.75	16	> 5.5	>4.5	> 3.5	> 2.5
Exchangeable Calcium	(cmol+/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	31	15.6	10.8	5.0	1.9
	(kg/ha)		13,899	7000	4816	2240	840
	(mg/kg)		6,205	3125	2150	1000	375
Exchangeable Magnesium	(cmol+/kg)		5.4	2.4	1.7	1.2	0.60
	(kg/ha)		1,467	650	448	325	168
	(mg/kg)		655	290	200	145	75
Exchangeable Potassium	(cmol+/kg)		2.4	0.60	0.50	0.40	0.30
	(kg/ha)		2,138	526	426	336	224
	(mg/kg)		954	235	190	150	100
Exchangeable Sodium	(cmol+/kg)		0.23	0.3	0.26	0.22	0.11
	(kg/ha)		118	155	134	113	57
	(mg/kg)		53	69	60	51	25
Exchangeable Aluminium	(cmol+/kg)	**Inhouse S37 (KCl)	0.02	0.6	0.5	0.4	0.2
	(kg/ha)		3.1	121	101	73	30
	(mg/kg)		1.4	54	45	32	14
Exchangeable Hydrogen	(cmol+/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	<0.01	0.6	0.5	0.4	0.2
	(kg/ha)		<1	13	11	8	3
	(mg/kg)		<1	6	5	4	2
Effective Cation Exchange Capacity (ECEC) (cmol+/kg)		**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg)	39	20.1	14.3	7.8	3.3
Calcium (%)		**Base Saturation Calculations - Cation cmol+/kg / ECEC x 100	79	77.6	75.7	65.6	57.4
Magnesium (%)			14	11.9	11.9	15.7	18.1
Potassium (%)			6.3	3.0	3.5	5.2	9.1
Sodium - ESP (%)			0.59	1.5	1.8	2.9	3.3
Aluminium (%)			0.04	6.0	7.1	10.5	12.1
Hydrogen (%)			0.00				
Calcium/Magnesium Ratio		**Calculation: Calcium / Magnesium (cmol+/kg)	5.7	6.5	6.4	4.2	3.2

Lab No		XSS20092	XSS20093	XSS20094
Name		East	North Front Paddock	West Block Paddock
Code		07/07/20	07/07/20	07/07/20
Customer		Warrnambool Veterinary	Warrnambool Veterinary	Warrnambool Veterinary
Depth		0-10	0-10	0-10
Colour		GR	DKGR	GR
Gravel	%	0	0	0
Texture		2.5	2.5	3.5
Ammonium Nitrogen	mg/kg	17	29	12
Nitrate Nitrogen	mg/kg	22	39	6
Phosphorus Colwell	mg/kg	203	318	94
Potassium Colwell	mg/kg	703	1129	257
Sulfur	mg/kg	10.1	14.1	10.0
Organic Carbon	%	4.43	5.90	3.78
Conductivity	dS/m	0.130	0.183	0.092
pH Level (CaCl2)		6.2	4.5	5.3
pH Level (H2O)		6.8	5.5	6.4
DTPA Copper	mg/kg	1.13	1.41	1.35
DTPA Iron	mg/kg	437.60	467.00	312.40
DTPA Manganese	mg/kg	7.76	33.15	18.74
DTPA Zinc	mg/kg	3.19	16.38	2.16
Exc. Aluminium	meq/100g	0.010	0.060	0.040
Exc. Calcium	meq/100g	20.22	20.07	18.13
Exc. Magnesium	meq/100g	6.38	6.67	12.25
Exc. Potassium	meq/100g	1.54	2.43	0.53

Here I have taken Megan's lab data and put it into one of my worksheets

Lab No		XSS20092	XSS20093	XSS20094
Name		East	North Front Paddock	West Block Paddock
Code		07/07/20		
Customer		Warrnambool Veterinary	Warrnambool Veterinary	Warrnambool Veterinary
Depth		0-10	0-10	0-10
Colour		GR	DKGR	GR
Gravel	%	0	0	0
Texture		2.5	2.5	3.5
Ammonium Nitrogen	mg/kg	17	29	12
Nitrate Nitrogen	mg/kg	22	39	6
Phosphorus Colwell	mg/kg	203	318	94
Potassium Colwell	mg/kg	703	1129	257
Sulfur	mg/kg	10.1	14.1	10.0
Organic Carbon	%	4.43	5.90	3.78
Conductivity	dS/m	0.130	0.183	0.092
pH Level (CaCl2)		6.2	4.5	5.3
pH Level (H2O)		6.8	5.5	6.4
DTPA Copper	mg/kg	1.13	1.41	1.35
DTPA Iron	mg/kg	437.60	467.00	312.40
DTPA Manganese	mg/kg	7.76	33.15	18.74
DTPA Zinc	mg/kg	3.19	16.38	2.16
Exc. Aluminium	meq/100g	0.010	0.060	0.040
Exc. Calcium	meq/100g	20.22	20.07	18.13
Exc. Magnesium	meq/100g	6.38	6.67	12.25
Exc. Potassium	meq/100g	1.54	2.43	0.53

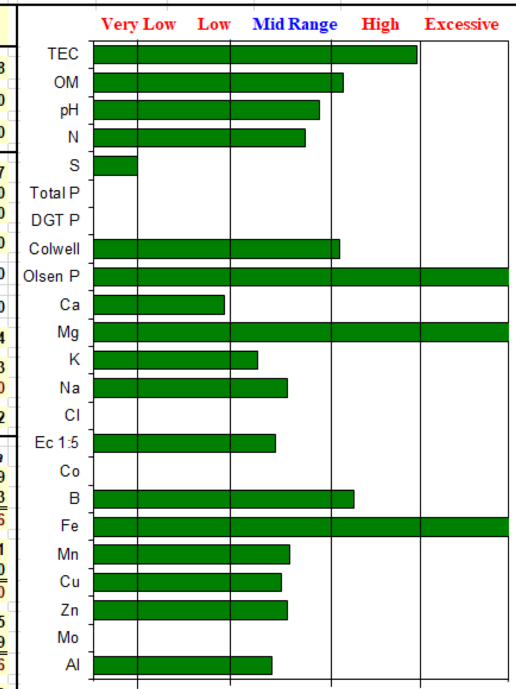
Lab No		XSS20092	XSS20093	XS
xc. Sodium	meq/100g	0.81	0.74	
oron Hot CaCl2	mg/kg	1.58	2.18	
hosphorus Olsen	mg/kg	48.9	73.7	
BI		227.7	189.7	

B L McLeod Premium Soil Report

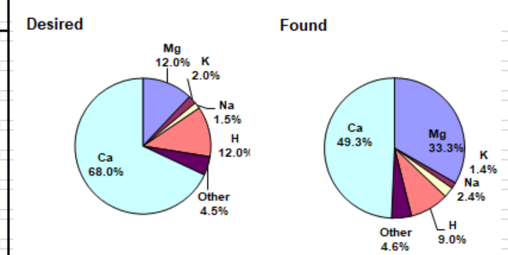
DATA FROM CSBP SUPPLIED by

Customer:	Meghan Claxton	Agent:	0
Sample Name:	WEST BLOCK PD		BRYAN MCLEOD
		Crop:	Pasture
Lab No.:	0	Date:	18-Jan-21

		Unit	Desired Level	Level Found
	Total Exchange Capacity (TEC)		12-25	33.98
	Colloidal Organic Matter	%	4.0 - 6.0	6.30
	pH (Water)		6.0 - 6.5	6.40
Anions	Nitrogen (N)	kg/ha	90 - 120	107
	NO 3	ppm		6.0
	NH 3	ppm		12.0
	MCP Sulfur (S)	ppm	40 - 60	10
	Total P	ppm		0
	DGT Phosphorus	ppm	0	0
	Phosphorus (Colwell)	ppm	75-85	94
	Phosphorus (Olsen)	ppm	33	73
		Deficit	kg/ha	0
	P Buffering Index (PBI)		<100	182
Cations			ppm	kg/ha
	Calcium (Ca)	Desired	4619	10379
		Found	3348	7523
		Deficit	kg/ha	2856
	Magnesium (Mg)	Desired	490	1101
		Found	1357	3050
		Deficit	kg/ha	0
	Potassium (K)	Desired	265	595
		Found	191	429
		Deficit	kg/ha	166
	Sodium(Na)	Found	94	212
	Chlorides (Cl)	ppm	<200	*
	Salinity EC 1:5	dS/m	<0.15	0.09
Trace Elements	Cobalt (Co)	ppm	>1.5	*
	Boron (B)	ppm	0.8	1.53
	DTPA Iron (Fe)	ppm	10 - 70	312.00
	DTPA Manganese (Mn)	ppm	4 - 50	18.74
	DTPA Copper (Cu)	ppm	0.5 - 5.0	1.35
	DTPA Zinc (Zn)	ppm	1.0 - 5.0	2.16
	Molybdenum (Mo)	ppm	0.8 - 2.0	*
	Aluminium (Al)	ppm	<2.0	0.40
Base Saturation %	Ca:Mg RATIO		5.66	1.48
	Calcium	% Ca	68.0	49.30
	Magnesium	% Mg	12.0	33.30
	Potassium	% K	2.0	1.40
	Sodium (ESP)	% Na	1.5	2.40
	Other Bases	%	4.5	4.60
	Exchangeable Hydrogen	% H	12.0	9.00



Base Saturation Percentages



Total Deficiencies: The following table shows the total deficiency of each element (kg/ha).

Please discuss optimum application rates with your advisor.

PHOSPHORUS	nd	BORON	nd	COBALT	1.5
MAGNESIUM	nd	IRON	nd	MOLYBDENUM	1.2
POTASSIUM	166	MANGANESE	83		
CALCIUM	2856	COPPER	1.3		
SULPHUR	40	ZINC	11.7	Cobalt Limit of Detection 0.2ppm	

* This test is available but not requested by client. nd = not deficient n req = not requested

proagcon@ozemail.com.au NZ 0212956469

Firstly understand what we are looking for

We must see what are the limiting factors in our soil

SOIL MINERALS: EXCESSES & DEFICIENCIES

Soil minerals can work together or be antagonistic to each other.

ALWAYS REMEMER:

Plant deficiencies not only occur due to lack of a soil element,

BUT

Are also created by excesses.

<u>An excess always creates a deficiency.</u>

SOIL		PLANT
Excess NITROGEN	*may cause*	POTASSIUM deficiency
Excess PHOSPHORUS	*may cause*	POTASSIUM, zinc, calcium OR Iron deficiency
Excess MAGNESIUM	*may cause*	POTASSIUM deficiency
Excess POTASSIUM	*may cause*	MAGNESIUM deficiency
Excess POTASSIUM **Excess** SODIUM **Excess** MAGNESIUM	*may cause*	CALCIUM deficiency
Excess CALCIUM	*may cause*	POTASSIUM deficiency MAGNESIUM deficiency PHOSPHORUS deficiency TRACE ELEMENTS deficiency
Excess MANGANESE	*may cause effects similar to*	MANGANESE deficiency
Excess BORON	*may cause marginal and interval scorch similar to*	POTASSIM and/or MAGNESIUM deficiency
Excess SODIUM &/or CHLORINE	*may cause marginal leaf scorch similar to*	POTASSIUM deficiency

EXCESSES MAY EXIST WHEN VALUES FOR……

NITROGEN (N)	are over	250 kgs per hectare
PHOSPHORUS (as P_2O_5)	are over	800 kgs per hectare
SODIUM (Na)	are over	2% Base Saturation
POTASSIUM (K)	are over	8% Base Saturation
MAGNESIUM (Mg)	are over	20% Base Saturation
CALCIUM (Ca)	are over	75% Base Saturation

KNOW AND REMEMBER

PRO AG CONSULTING

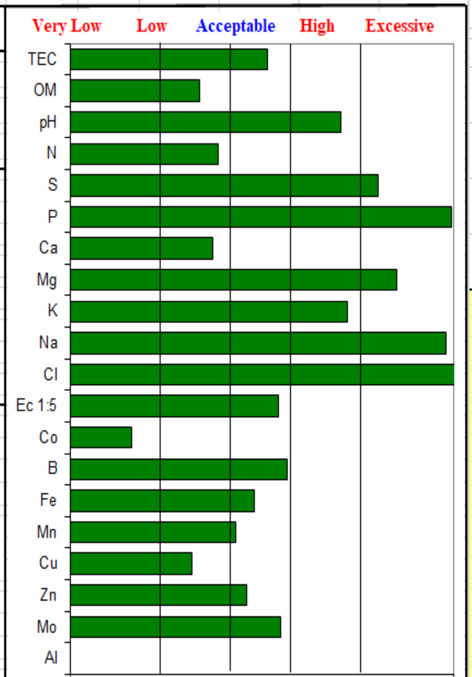
Customer:		*Advisor:*	
		Organic Consultants	
Sample Name:		*Crop:*	
STH SIDE		SPINACH	
Control 12557	Lab No.: B0020	*Date:*	9-Aug-07

	Unit	Desired Level	Level Found
Total Exchange Capacity (TEC)		12-25	**19.81**
Colloidal Organic Matter %		4.0 - 6.0	**3.20**
pH (Water)		6.0 - 6.5	**8.00**
Anions			
Nitrogen (N)	kg/ha	90 - 120	82
NO 3	ppm		*
NH 3	ppm		*
Sulphate (S)	ppm	20 - 30	84
Olsen (P)	ppm	55-65	111
Phosphorus (Bray 2)	kg/ha	324	570
Deficit	*kg/ha*	*Units P*	0
Phosphate Recovery	%	100	80

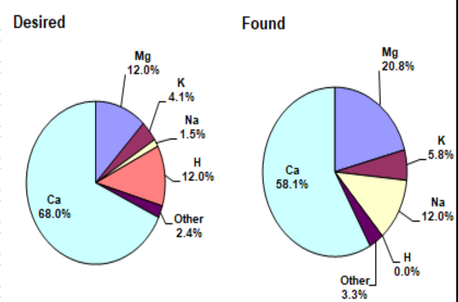
Cations		ppm	kg/ha
Calcium (Ca)	Desired	2692	6050
	Found	2298	5165
	Deficit		885
Magnesium (Mg)	Desired	285	640
	Found	494	1111
	Deficit		0
Potassium (K)	Desired	320	719
	Found	445	999
Sodium(Na)	Deficit		0
	Found	545	1224

	Unit	Desired Level	Level Found
Chlorides (Cl)	ppm	<250	1656.0
Salinity EC 1:5	dS/m	<0.15	0.41
Trace Elements			
Cobalt (Co)	ppm	>1.5	0.57
Boron (B)	ppm	>1.5	1.95
Iron (Fe)	ppm	100 - 400	290.00
Manganese (Mn)	ppm	80 - 140	83.00
Copper (Cu)	ppm	>2.0	1.50
Zinc (Zn)	ppm	>8.0	11.00
Molybdenum (Mo)	ppm	0.8 - 1.2	1.80
Aluminium (Al)	ppm	<2.0	*
Base Saturation %			
Ca:Mg RATIO		5.67	2.79
Calcium	% Ca	68.0	58.10
Magnesium	% Mg	12.0	20.80
Potassium	% K	4.1	5.80
Sodium	% Na	1.5	12.00
Other Bases	%	2.4	3.30
Exchangeable Hydrogen	% H	12.0	0.00

* This test is available but not requested by client.



Base Saturation Percentages



Additional Comments:

The following show the kg/ha of deficient elements required to bring the soil to the ideal level

PHOSPHORUS	nd	BORON	nd	COBALT	0.6
MAGNESIUM	nd	IRON	nd	MO	nd
POTASSIUM	nd	MANGANESE	nd		
CALCIUM	885	COPPER	1.0		
SULPHUR		ZINC	nd		

nd = not deficient n req = not requested

PRO AG CONSULTING

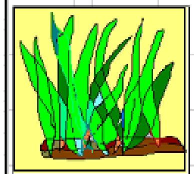
CROP **SPINACH**

Report Prepared by Bryan L McLeod

Email: proagcon@ozemail.com.au

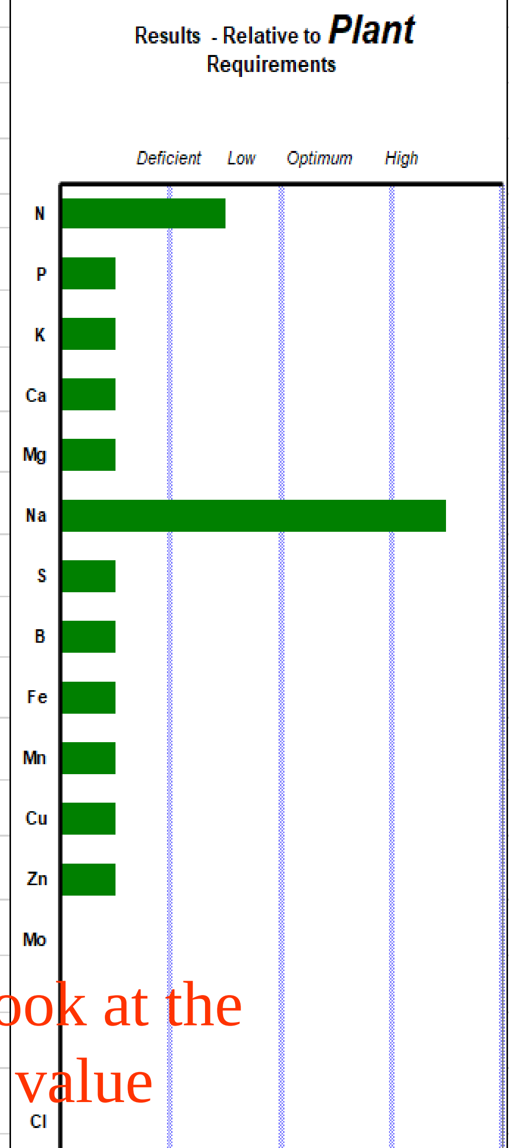
Plant analysis report -

Date: Agent B McLEOD Sample: **SPINACH**



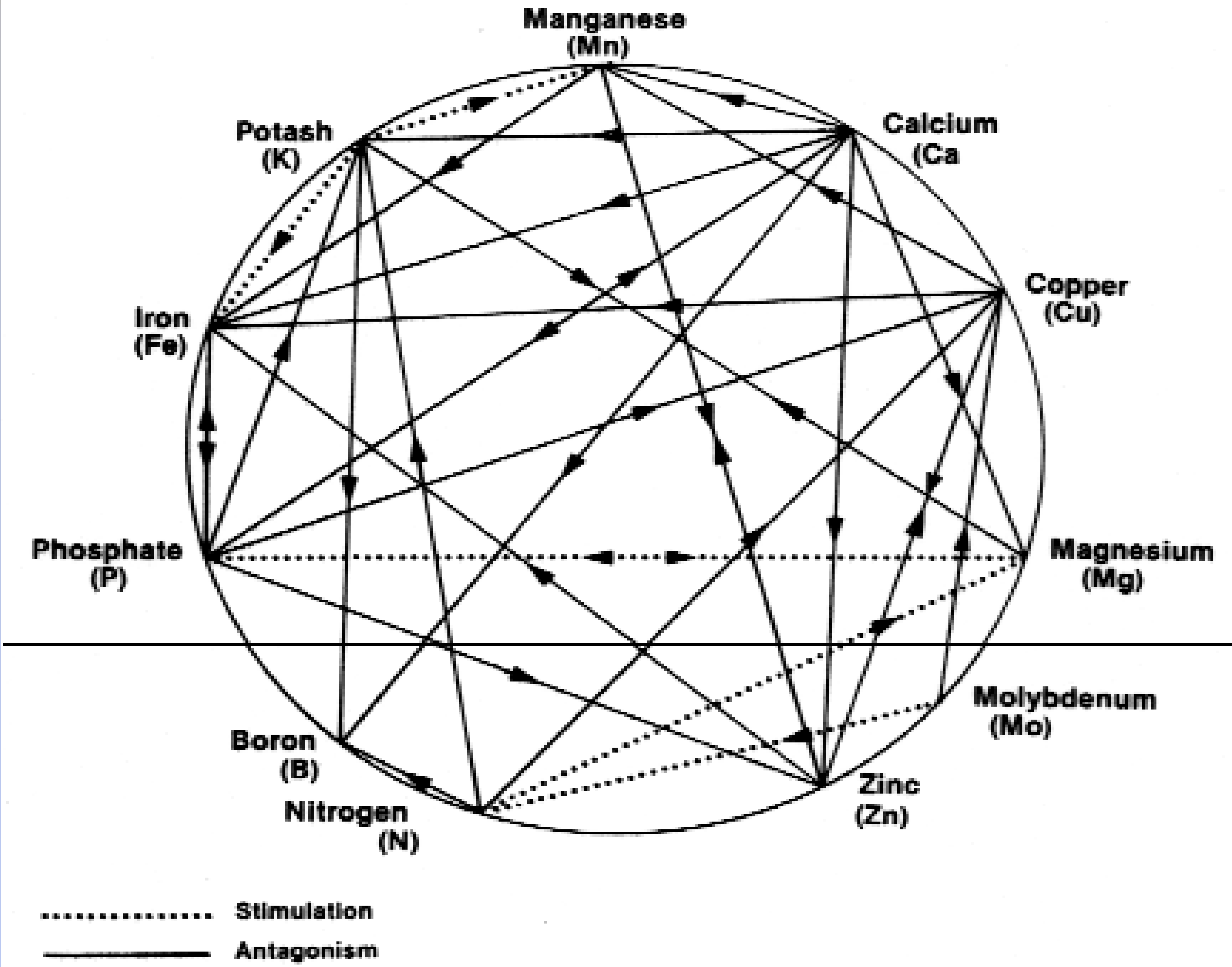
Your Test Results

Element	Unit	Desired Range	Your Test Results
Nitrogen	%	4.20 - 5.20	3.39
Phosphorus	%	0.48 - 0.58	0.27
Potassium	%	3.50 - 5.30	2.27
Calcium	%	0.60 - 1.20	0.29
Magnesium	%	0.50 - 0.90	0.19
Sodium	%	0.10 - 1.00	1.16
Sulphur	%	0.40 - 0.80	0.20
Boron	ppm	42 - 63	18.42
Iron	ppm	220 - 245	26.76
Manganese	ppm	50 - 85	11.54
Copper	ppm	8 - 20	2.47
Zinc	ppm	40 - 80	12.96
Molybdenum	"	0.15 - 0.30	
Chloride	%	0.1 - 0.23	



We must look at the nutritional value

STIMULATION AND ANTAGONISM CHART



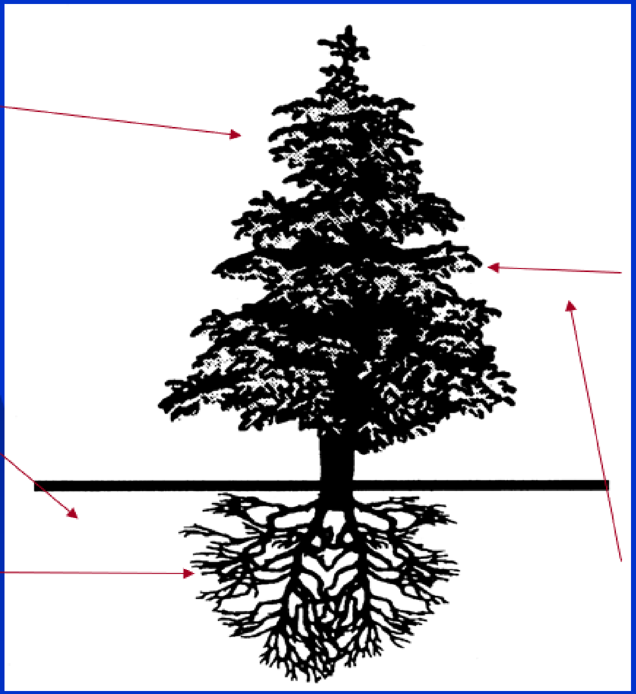
Plants have two different life requirements Above ground and below

Atmosphere CO2

Water takes Oxygen

Into soil

Oxygen



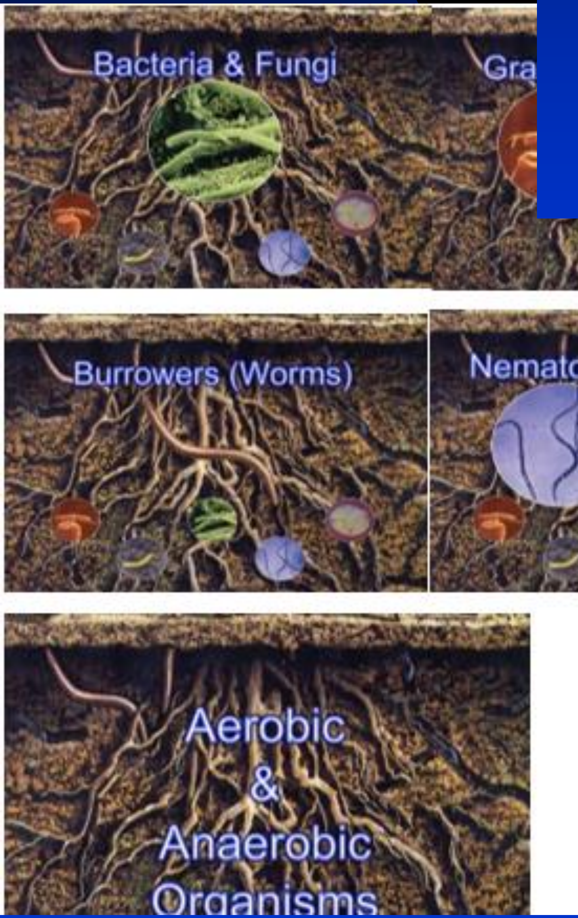
Tops require C02.

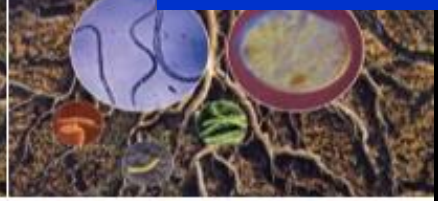
Reduced performance with

high Oxygen C02. Note most C02 comes from soil

C02 from microbial activity

Roots require oxygen. Die with excess C02





Soil activity is continuously producing C02 and releasing it to the atmosphere

Desirable soil life requires O2

Soil analysis results will use the words CATIONS + ANIONS-

POSITIVE

- Calcium 60 - 68%
- Magnesium 12 - 20%
- Potassium 3- 6%
- Sodium 1.5%
- Other Bases 2.5%
- Hydrogen 12%
- Total 100%

All positives held to the negative soil particle

NEGATIVE

- Sulphur
- Phosphorus
- Nitrogen

Clay or OM Negatively Charged

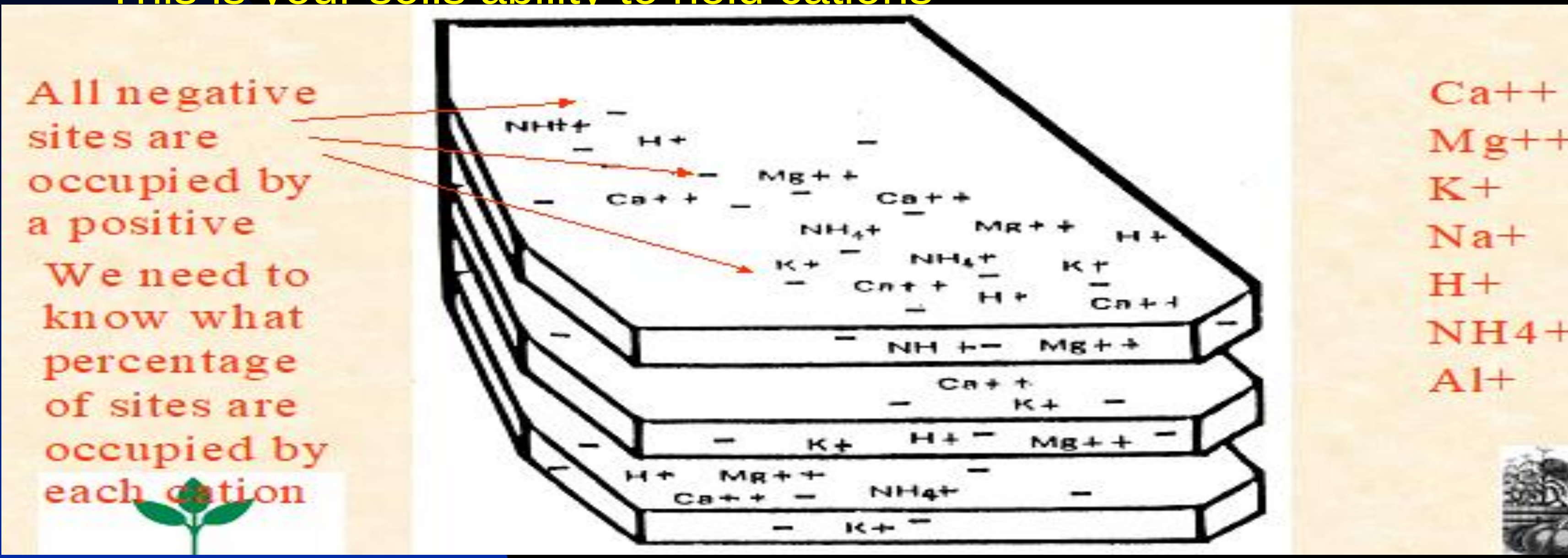
What I look at in what order

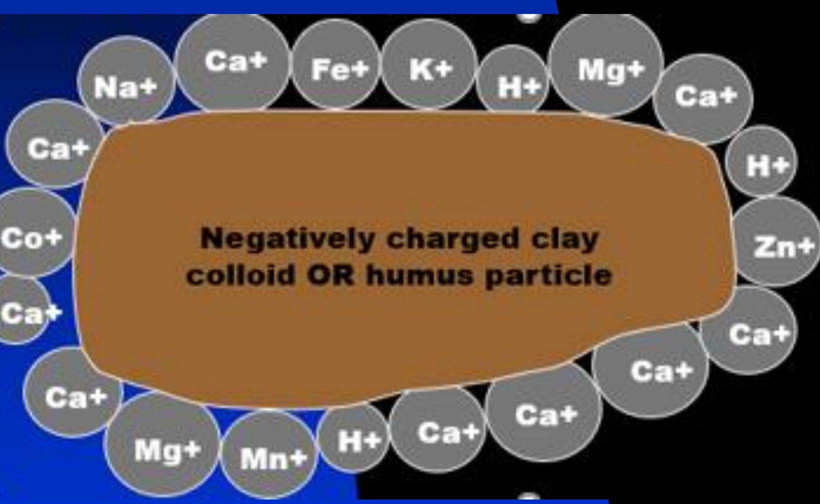
1. CEC/TEC (Cation Exchange Capacity or Total Exchange Capacity)
2. PH, how is it constructed – See Base Saturation Percentages – Some show you some you will need to calculate
3. Organic Carbon or OM, low or high?
4. Soil N
5. Sulphur level
6. P level
7. PBI - P recovery – P retention
8. Cations
9. Excesses and deficiencies – An excess of one always creates a plant deficiency of another
10. Calculate desired and deficiencies
11. Trace elements

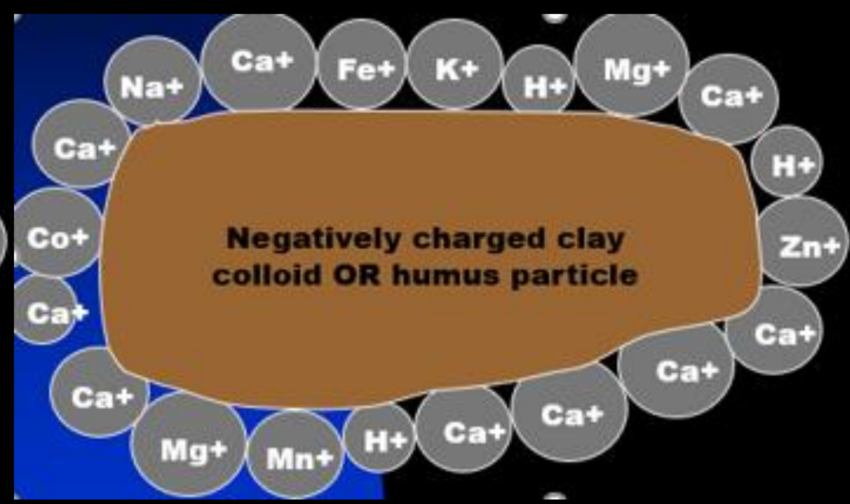
Total Exchange Capacity TEC or Cation Exchange Capacity CEC

Tells us

- your soils composition – how many negative clay/OM sites there are to hold positively charged cations (Ca, Mg, K, Na, Al)
- This is your soils ability to hold cations







Ca	68%
Mg	12%
K	2-5%
Na	1.5%
OB	5%
H	12%
PH	6.2

TOTAL EXCHANGE CAPACITY
Where does it come from?

- It is the total of the cations, positive charged elements, Ca, M, K, Na, Al, measured in meq/100g soil or c.mol/kg
- See it in your soil report

- It is a measure of the positive charged, nutrient storage capacity of a soil.
- It tells you the nutrient storage capacity of your soil

You can find the CEC/TEC in the majority of tests if not we can calculate it

Lab No		XSS20092	XSS20093	XSS20094
Name		East	North Front Paddock	West Block Paddock
Code		07/07/20	07/07/20	07/07/20
Customer		Warrnambool Veterinary	Warrnambool Veterinary	Warrnambool Veterinary
Depth		0-10	0-10	0-10
Colour		GR	DKGR	GR
Gravel	%	0	0	0
Texture		2.5	2.5	3.5
Ammonium Nitrogen	mg/kg	17	29	12
Nitrate Nitrogen	mg/kg	22	39	6
Phosphorus Colwell	mg/kg	203	318	94
Potassium Colwell	mg/kg	703	1129	257
Sulfur	mg/kg	10.1	14.1	10.0
Organic Carbon	%	4.43	5.90	3.78
Conductivity	dS/m	0.130	0.183	0.092
pH Level (CaCl2)		6.2	4.5	5.3
pH Level (H2O)		6.8	5.5	6.4
DTPA Copper	mg/kg	1.13	1.41	1.35
DTPA Iron	mg/kg	437.60	467.00	312.40
DTPA Manganese	mg/kg	7.76	33.15	18.74
DTPA Zinc	mg/kg	3.19	16.38	2.16
Exc. Aluminium	meq/100g	0.010	0.060	0.040
Exc. Calcium	meq/100g	20.22	20.07	18.13
Exc. Magnesium	meq/100g	6.38	6.67	12.25
Exc. Potassium	meq/100g	1.54	2.43	0.53
Exc. Sodium	meq/100g	0.81	0.74	0.89
Boron Hot CaCl2	mg/kg	1.58	2.18	1.53

It's the sum of the Cations, Ca, Mg, K, Na, Al, H in meq/100gm

		BSP
Ca	18.13	49.30
Mg	12.25	33.30
K	0.53	1.44
Na	0.89	2.42
Al	0.040	0.11
OB	2.8	5.0
H	0.58	9.0
Total	35.22	CEC

Megan's report there is no TEC/CEC or Base Saturation Percentages(BSP) recorded so it needs to be calculated

Add the meq/100gm of each ie Ca Mg K Na Al H(if shown) = the TEC, here it is 35.22

Ca 18.13meg	**divide Ca by the CEC x 100 = 49.30% BSP**
Mg 12.25	**divide Mg by the CEC x 100 = 33.30% BSP**
K 0.53	**divide K by the CEC x 100 = 1.44% BSP**
Na 0.89	**divide Na by the CEC x 100 = 2.42% BSP**
Al 0.040	**divide Al by the CEC x 100 = 0.11% BSP**
Total 31.84	

OB	**2.8**	**5.0**	**I have taken the liberty to add a percentage for both other bases and H which I believe gives a more accurate result**
H	**0.58**	**9.0**	

Total 35.22 CEC **I have used this CEC figure for my calculation**

Analysis
Laboratory

E: eal@scu.edu.au
www.scu.edu.au/eal

ABN: 41 995 651 524

RICULTURAL SOIL ANALYSIS REPORT

ple supplied by FarmLab on 12/11/2020. Lab Job No.K0574
is requested by Sam Duncan. Your Job: Ray Milidoni - FL0000218
2, W40 ARMIDALE NSW 2351

Parameter		Method reference	Sample 1 Sample ID: FL0000218 Crop: Soil Client: Ray Milidoni K0574/1	*Heavy Soil* *Clay*	*Medium Soil* *Clay Loam*	*Light Soil* *Loam*	*Sandy Soil* *Loamy Sand*
				Indicative guidelines - refer to Notes 6 and 8			
uble Calcium (mg/kg)			5,574	1150	750	375	175
changeable Calcium	(cmol+/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	31	15.6	10.8	5.0	1.9
	(kg/ha)		13,899	7000	4816	2240	840
	(mg/kg)		6,205	3125	2150	1000	375
changeable Magnesium	(cmol+/kg)		5.4	2.4	1.7	1.2	0.60
	(kg/ha)		1,467	650	448	325	168
	(mg/kg)		655	290	200	145	75
changeable Potassium	(cmol+/kg)		2.4	0.60	0.50	0.40	0.30
	(kg/ha)		2,138	[illegible]	426	336	224
	(mg/kg)		954	235	[illegible]	150	100
changeable Sodium	(cmol+/kg)		0.23	0.3	0.26	0.22	0.11
	(kg/ha)		118	[illegible]	134	113	57
	(mg/kg)		53	69	60	51	25
changeable Aluminium	(cmol+/kg)	**Inhouse S37 (KCl)	0.02	0.6	0.5	0.4	0.2
	(kg/ha)		3.1	121	101	73	30
	(mg/kg)		1.4	54	45	32	[illegible]
changeable Hydrogen	(cmol+/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	<0.01	0.6	0.5	0.4	0.2
	(kg/ha)		<1	13	11	8	3
	(mg/kg)		<1	6	5	4	2
ective Cation Exchange Capacity ECEC) (cmol+/kg)		**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg)	39	20.1	14.3	7.8	[illegible]
lcium (%)		**Base Saturation Calculations - Cation cmol+/kg / ECEC x 100	79	77.6	75.7	65.6	57.4
gnesium (%)			14	11.9	11.9	15.7	18.1
tassium (%)			6.3	3.0	3.5	5.2	9.1
dium - ESP (%)			0.59	1.5	1.8	2.9	3.3
uminium (%)			0.04	6.0	7.1	10.5	12.1
drogen (%)			0.00				
lcium/Magnesium Ratio		**Calculation: Calcium / Magnesium (cmol+/kg)	5.7	6.5	6.4	4.2	3.2

EAL add
Ca, Mg, K, Na
Al and H
PH >7 so no H

Ca 31

Mg 5.4

K 2.4

Na 0.23

Al 0.02

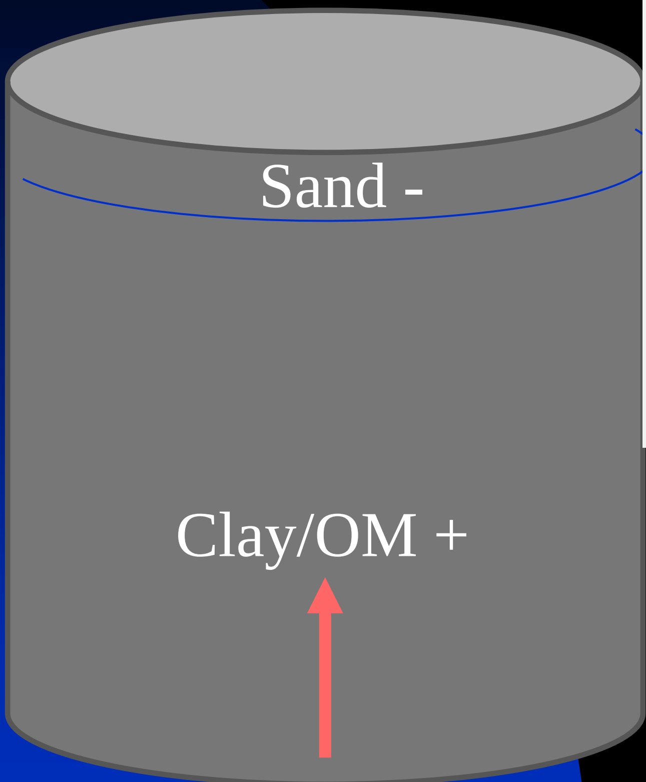
Total 39.05 CEC

What if your report doesn't show meg/100gm or cmol/kg But only shows ppm we can calculate each one

	PH 5.6		If pH is <7.0 include H for your calculations see H chart				Multiply each by 0.73	
	ppm			(meq/100g)		BSP	Actual % including H	
Calcium	3500		divide by 200	17.5	divide by CEC x 100	72.0	52.5	
Magnesium	600		divide by 120	5.0	divide by CEC x 100	20.4	14.9	
Potassium	300		divide by 390	0.8	divide by CEC x 100	3.2	2.3	
Sodium	250		divide by 230	1.1	divide by CEC x 100	4.5	3.3	
		CEC		24.31		100.0	73.0	
					From H chart	27.0	27.0	hydrogen%
					Minus H	73.0	100.0	

https://ohioline.osu.edu/factsheet/anr-81

The analysis only tests the clay/OM content, so as the sand % increases the TEC/CEC decreases. This means that there is a lower % of exchange sites in your soil to hold nutrients

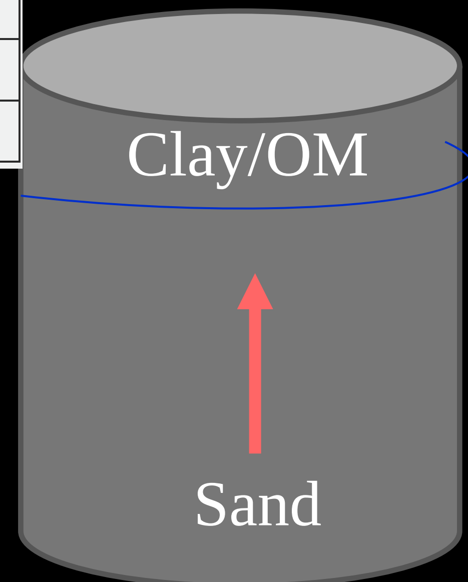


As clay/OM % increases TEC goes up so we have a greater capacity to hold nutrients

Table 1. The relationship between soil texture and CEC	
Soil Texture	**Typical CEC (meq/100 g soil)**
Sands	3-5
Loams	10-15
Silt loams	15-25
Clay and clay loams	20-50
Organic soils	50-100

- Percentage of clay/OM only. Sand is neutral

Both hold 100% when full but volume is different. The size of the tank/reserve is totally different

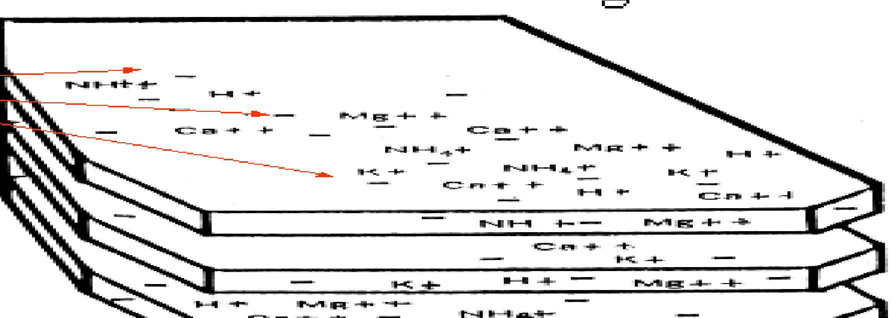


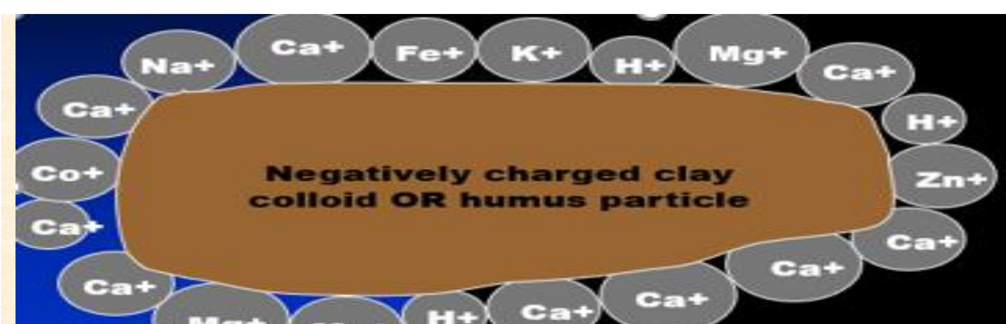
As sand % goes up TEC decreases, nutrient holding capacity goes down

High TEC					
Ca^{2+}	Ca^{2+}	Mg^{2+}	Al^{3+}	Fe^{3+}	Ca^{2+}
Ca^{2+}	Zn^{2+}	Ca^{2+}	H^{+}	Mg^{2+}	H^{+}
Mg^{2+}	Ca^{2+}	Ca^{2+}	H^{+}	Zn^{2+}	Fe^{3+}
H^{+}	Zn^{2+}	H^{+}	Fe^{3+}	Al^{3+}	H^{+}
Ca^{2+}	Fe^{3+}	Mg^{2+}	Mg^{2+}	Ca^{2+}	Ca^{2+}
Ca^{2+}	H^{+}	Ca^{2+}	Mg^{2+}	H^{+}	H^{+}

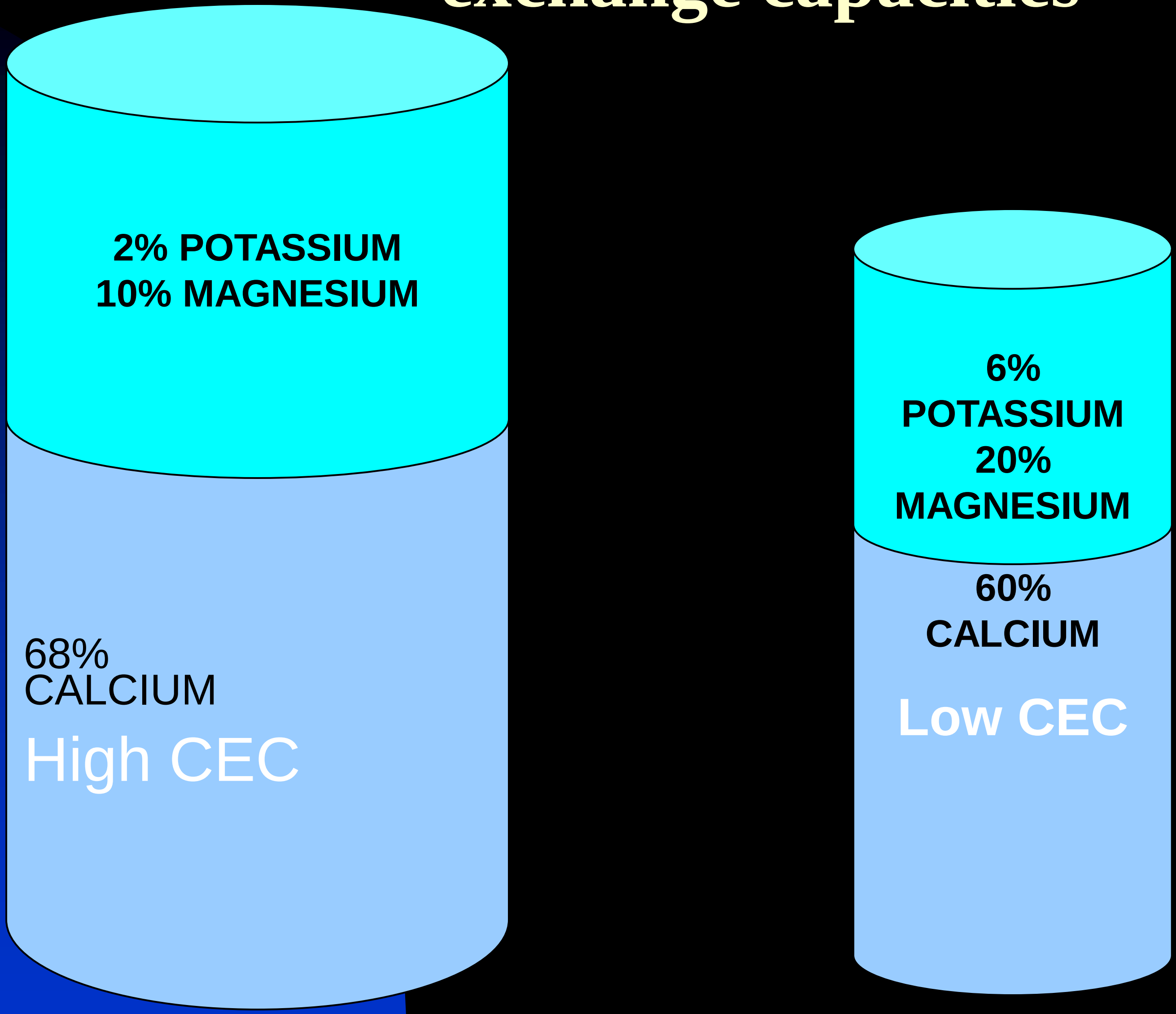
Low TEC					
Ca^{2+}	Ca^{2+}	Mg^{2+}	Al^{3+}	Fe^{3+}	
Ca^{2+}			H^{+}	Mg^{2+}	H^{+}
Mg^{2+}	Ca^{2+}			Zn^{2+}	
		H^{+}	Fe^{3+}	Al^{3+}	H^{+}
Ca^{2+}		Mg^{2+}	Mg^{2+}		Ca^{2+}
Ca^{2+}		Ca^{2+}	Mg^{2+}	H^{+}	

Figure 1 **Schematic diagram demonstrating the reduced nutrient storage sites for a soil with a low TEC when compared to a soil with a high TEC.**





Variations of desired percentages with different exchange capacities



High TEC > 25

Low TEC <5

	Unit	Desired Level	Level Found	c.mol/kg
ECEC	cmol/kg	5.00-25.0	22.6	
Organic Carbon (W&B)	%	1.20-2.00	0.540	
pH 1:5 water	pH units	6.50-7.50	6.48	
pH CaCl2 (following 4A1)	pH units	5.50-6.50	6.23	
Nitrate - N (2M KCl)	mg/kg	20-50	160	
Ammonium - N (2M KCl)	mg/kg	2.0-10	12	
Olsen Phosphorus	mg/kg	15-25	1.9	
Colwell Phosphorus	mg/kg	25-29	5.0	
Bray 2 Phosphorus	mg/kg	30-60	6.0	
DGT-P	µg/L		13.0	
PBI Unadjusted		35.0-70.0	6[illegible]0	
MCP Sulfur (S)	mg/kg	8.0-20	41	
Calcium (Ca) - AmmAc	mg/kg	1200-2500	1830	9.14
Magnesium (Mg) - AmmAc	mg/kg	200-350	850	6.99
Potassium (K) - AmmAc	mg/kg	150-220	363	0.928
Sodium (Na) - AmmAc	mg/kg	15.0-160	1260	5.50
Exchangeable aluminium	cmol/kg	0.10-0.35	<0.02	
Exchangeable hydrogen	cmol/kg	0.10-0.35	<0.02	
Boron	mg/kg	0.50-2.0	1.4	

Labs often give a wide range of desired levels

Desired levels are directly related to the TEC/CEC

TEC	5	10	15	20
Desired	ppm	ppm	ppm	ppm
Ca	600	1360	2040	2720
Mg	121	145.2	217.8	290.4
K	156	195	234	296.4
Na	17.25	34.5	51.75	69

AGRICULTURAL SOIL ANALYSIS REPORT

Desired % maybe the same but volumes and ppm will be different

1 sample supplied by FarmLab on 12/11/2020. Lab Job No.K0574
Analysis requested by Sam Duncan. Your Job: Ray Milidoni - FL0000218
Level 2, W40 ARMIDALE NSW 2351

Parameter	Unit	Method	Sample 1	Heavy Soil	Medium Soil	Light Soil	Sandy Soil
Exchangeable Calcium	(cmol$_+$/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	31	15.6	10.8	5.0	1.9
	(kg/ha)		13,899	7000	4816	2240	840
	(mg/kg)		6,205	3125	2150	1000	375
Exchangeable Magnesium	(cmol$_+$/kg)		5.4	2.4	1.7	1.2	0.60
	(kg/ha)		1,467	650	448	325	168
	(mg/kg)		655	290	200	145	75
Exchangeable Potassium	(cmol$_+$/kg)		2.4	0.60	0.50	0.40	0.30
	(kg/ha)		2,138	526	426	336	224
	(mg/kg)		954	235	190	150	100
Exchangeable Sodium	(cmol$_+$/kg)		0.23	0.3	0.26	0.22	0.11
	(kg/ha)		118	155	134	113	57
	(mg/kg)		53	69	60	51	25
Exchangeable Aluminium	(cmol$_+$/kg)	**Inhouse S37 (KCl)	0.02	0.6	0.5	0.4	0.2
	(kg/ha)		3.1	121	101	73	30
	(mg/kg)		1.4	54	45	32	14
Exchangeable Hydrogen	(cmol$_+$/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	<0.01	0.6	0.5	0.4	0.2
	(kg/ha)		<1	13	11	8	3
	(mg/kg)		<1	6	5	4	2
Effective Cation Exchange Capacity (ECEC) (cmol$_+$/kg)		**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol$_+$/kg)	39	20.1	14.3	7.8	3.3
Calcium (%)		**Base Saturation Calculations - Cation cmol$_+$/kg / ECEC x 100	79	77.6	75.7	65.6	57.4
Magnesium (%)			14	11.9	11.9	15.7	18.1
Potassium (%)			6.3	3.0	3.5	5.2	9.1
Sodium - ESP (%)			0.59	1.5	1.8	2.9	3.3
Aluminium (%)			0.04	6.0	7.1	10.5	12.1
Hydrogen (%)			0.00				
Calcium/Magnesium Ratio		**Calculation: Calcium / Magnesium (cmol$_+$/kg)	5.7	6.5	6.4	4.2	3.2

EXCHANGE CAPACITY & APPLICATION RATES

		3 TEC	PPM		30 TEC	PPM
Desired Calcium	60%	816 Kgs/ha	408	(Ca68%)	8160 Kgs/ha	4080
Measured Calcium	34%	408 Kgs/ha	204	(Mg 12%)	4080 Kgs/ha	2040
Deficiency Kgs		408 Kgs/ha		4080 Kgs/ha		
Lime Required		1.2 tn/ha			11.6 tn/ha	
Magnesium	20%	144 Kgs/ha	77	(Mg 12%)	720 Kgs/ha	360
		72 Kgs/ha	36		360 Kgs/ha	180
		72 Kgs/ha			360 Kgs/ha	
Potassium	7%	164 Kgs/ha	82	(K 3%)	702 Kgs/ha	351
		81.9 Kgs/ha	42		351 Kgs/ha	175.5
		81.9 Kgs/ha	42		351 Kgs/ha	

PH

Look at the pH but most importantly study to see just how the pH is constructed – this is the most important thing you must know about pH

PH is only a measurement of the hydrogen ion activity in a soil. It is not a measurement of soil fertility.

PH is the result of the balance or levels of cations (positive charged elements) not the cause of it.

The PH of a soil can be constructed with one or all of the cations. Not just calcium

The application of calcium, magnesium, potassium and sodium construct a pH.

Do you lime for PH

or do you lime to correct a Ca def

You should never lime for pH

The PH is automatic when the soils Cations are balanced

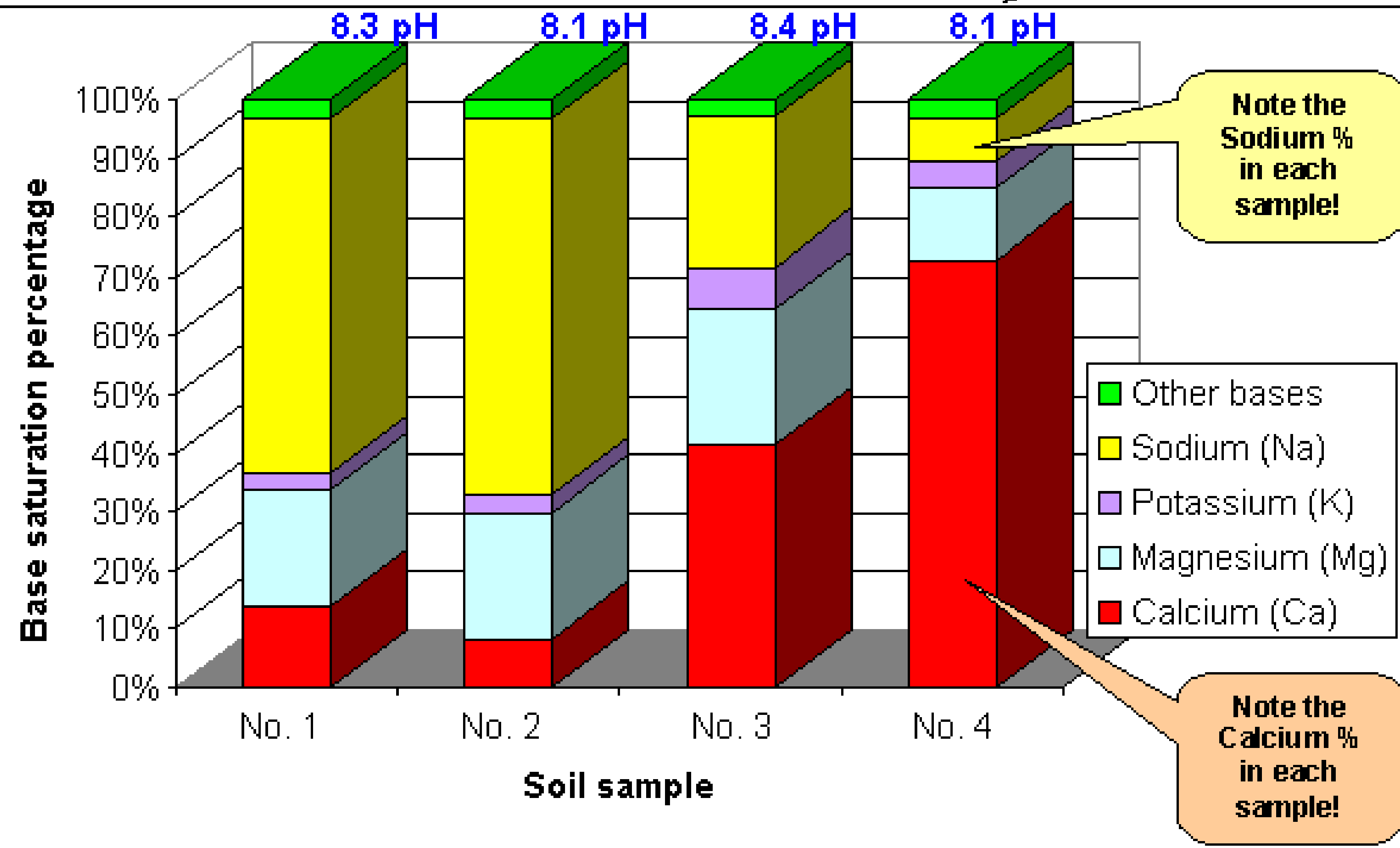
Understand that

- Magnesium is 1.66 times more effective than calcium at raising pH
- Potassium 2 times calcium
- Sodium 4 times calcium.

WHAT CONSIDERATION IS PH

Actual results from samples I have taken

pH(H2O)	6.20	6.00	6.00	7.80	5.80
Calcium	63%	45.98	23.61	37.43	7.10
Magnesium	14%	20.36	21.70	19.64	14.35
Potassium	4.2%	6.12	1.81	6.50	0.63
Sodium	1.6%	7.16	32.46	32.83	51.10
Other Bases	5.2%	5.40	5.42	3.60	5.80
Hydrogen	12%	15.00	15.00	00.00	21.00


Note that the pH is nearly the same for the 4 samples!
8.3 pH
8.1 pH
8.4 pH
8.1 pH
Base saturation percentage
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
No. 1
No. 2
No. 3
No. 4
Soil sample
Other bases
Sodium (Na)
Potassium (K)
Magnesium (Mg)
Calcium (Ca)
Note the Sodium % in each sample!
Note the Calcium % in each sample!

Organic Matter/Organic Carbon

OM = OC x 1.75 or OM/1.75 = OC

Calculations can be slightly different between labs as some use 1.66

Dad's OM = 16% Indicating a high percentage of composed and partly composted plant material

Megan's OC of 3.78% x 1.75 = 6.4% OM. At the top of the desired range

- **Ideal level of OM 4 to 6%**
- **Excess unprocessed OM can result in low available soil N**
- **Soils can contain undecomposed or partly decomposed OM which during the analysis process can recorded as OC or OM**

- **Soil organisms involved in decomposition use nearly all available N for themselves, so plants go N deficient**
- **I find this to be common in many orchards/gardens**

Application Rates

To compare per ha rates to garden rates, firstly there are 10,000sq metres/ha

Multiply per ha rate by 1000 = total gms then divide by 10,000 = rates/sq metre

eg 200kg/ha X 1000 = 200,000 gm/10,000 = 20gm/sq metre

SULPHUR The under estimated element of equal importance as P

Essential for growth, plant nitrogen utilisation

Sulphate S is water soluble so leaches quickly depending on rainfall/irrigation, elemental S breaks down slowly so is more stable in the soil

Ideal soil level should be 40 to 60ppm.

The majority of labs indicate a desired level of between 10 to 20ppm in practable terms this is far to low for optimum produce production

Application: Desired 50ppm – level found x 2 x 1.123 = kg/ha required, do not apply more than 60kg/ha of element S per annum

Can be added to mix as

- elemental S as 90% Sulphur granules – these are fine elemental powder mixed with bentonite clay. Do not apply 100% S granules as they take a significant time to break down
- Apply elemental S granules fert mix with to reduce total fertiliser cost when P not required
- Gardens use Sulphate of ammonia to provide S
- Single super (superphosphate) contains 11% S

Phosphorus

Your P analysis readings can be received in different forms as many lab
use different analyse procedures

- Colwell P
- Olsen P
- Bray 1 P
- Bray 2 P
- DGT

	**Rayment & Lyons 2011 - 9E2 (Bray 1)	295	[illegible]
osphorus (mg/kg P)	**Rayment & Lyons 2011 - 9B2 (Colwell)	859	
	**Inhouse SSA (Bray 2)	1,292	[illegible]

PBI Phosphorus Buffering index <100 desired
P Retention % of 100
P Recovery % of 100

Phosphorus

The desire levels should be on your report.

Application: Desired ppm – level found x 2 x 1.123 = kg/ha required.

Then look at the % of P in available products

Eg. Rock Phosphate 13%, Single Super (Super Phosphate 11%) DAP 20%

Then work out an economic rate of application

Dad's garden – normal results from compost applications

Phosphorus (mg/kg P)	**Rayment & Lyons 2011 - 9E2 (Bray 1)	295	45 [note 8]	30 [note 8]	24 [note 8]	20 [note 8]
	**Rayment & Lyons 2011 - 9B2 (Colwell)	859	80	50	45	35
	**Inhouse S3A (Bray 2)	1,292	90 [note 8]	60 [note 8]	48 [note 8]	40 [note 8]

Phosphorus Colwell	mg/kg	203	318	94

Megan's pasture

Both reports show high to excess levels of P

P Calculation example

Desired level minus level found x 2 x 1.123 = kg of P/ha
Divide by 10,000 = gm/sq metre of garden

Found 20ppm, desired 30ppm = 10 def then see percentages of P product list

Then choose product from local company products

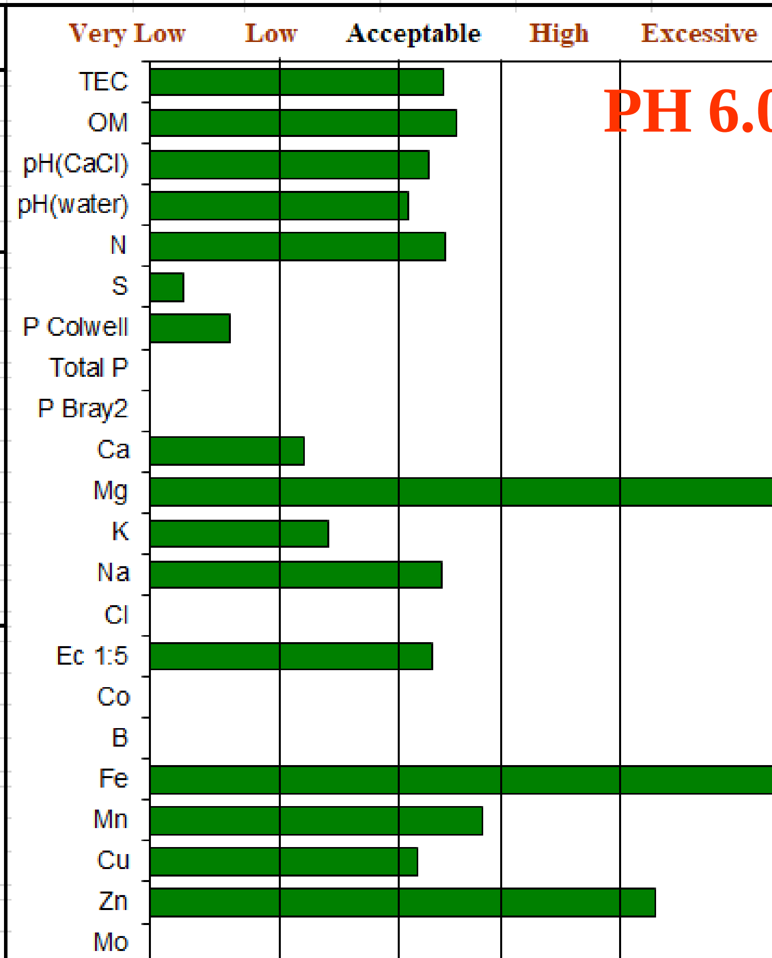
Superten			N	P	K	S	Mg	Ca
	CODE							
	10581	Superten	-	9.0	-	10.5	-	22.0
	10754	Superten 5K (10% Potash superten)	-	8.1	5.0	9.5	-	19.8
	10755	Superten 7K (15% Potash superten)	-	7.7	7.5	8.9	-	18.7
	10757	Superten 10K (20% Potash superten)	-	7.2	10.0	8.4	-	17.6
	10759	Superten 15K (30% Potash superten)	-	6.3	15.0	7.4	-	15.4
	10761	Superten 25K (50% Potash superten)	-	4.5	25.0	5.3	-	11.0

Sulphurgain			N	P	K	S	Mg	Ca
	CODE							
	10060	Sulphurgain 15S	-	8.6	-	14.8	-	21.0
	10032	Sulphurgain 20S	-	8.0	-	20.0	-	19.8
	10033	Sulphurgain 30S	-	7.0	-	29.5	-	17.5
	11625	Sulphurgain Pure	-	-	-	90.0	-	-

Most labs show the % of Ca, Mg, K & Na (Base Saturation percentages)

Control Gregory sites		Lab No.:	Gregory sites	Date:	10-Jul-20

		Unit	Desired Level	Level Found
	Total Exchange Capacity (TEC)		12-25	15.83
	Colloidal Organic Matter	%	4.0 - 6.0	4.83
	pH (Water)		6.0 - 6.5	6.00
	pH CaCl			5.30
Anions	Nitrogen (N)	kg/ha	90 - 120	99
	NO 3	ppm		0.6
	NH 3	ppm		1590.0
	MCP Sulfur (S)	ppm	40 - 60	5
	Total Phosphorus	ppm		0
	Phosphorus (Colwell)	ppm	30 - 50	9
	Def or Excess Colwell P	Kg/ha		69
	Phosphorus (Bray 2)	kg/ha	113	0
	Olsen P	ppm	21	
	P Buffering Index (PBI)		<100	0
Cations			ppm	kg/ha
	Calcium (Ca)	Desired	2152	4837
		Found	1210	2719
		Deficit	kg/ha	2118
	Magnesium (Mg)	Desired	285	640
		Found	726	1631
		Deficit	kg/ha	0
	Potassium (K)	Desired	216	485
		Found	122	274



PH 6.0

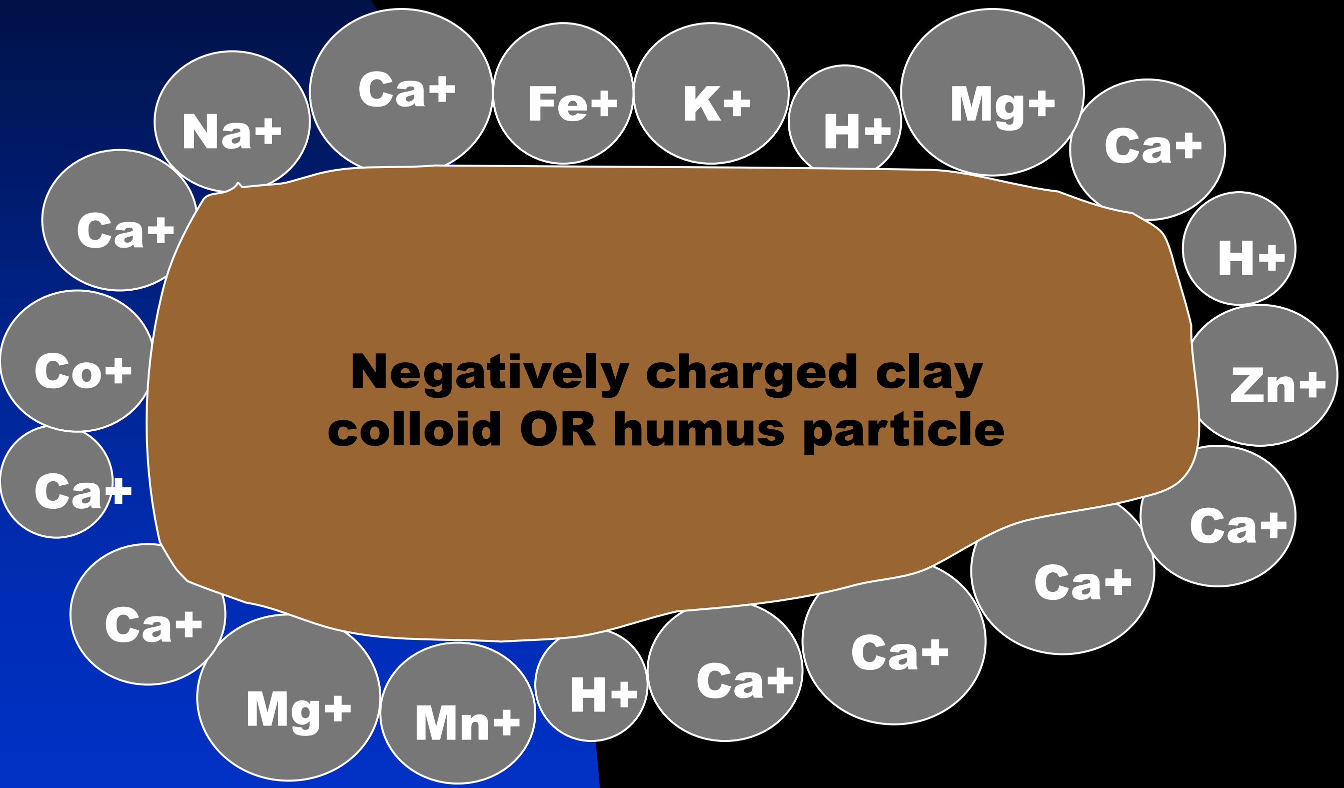
Data must include a H% or you can add it for your calculations

Base Saturation %				
	Ca:Mg RATIO		5.67	1.00
	Calcium	% Ca	68.0	38.2
	Magnesium	% Mg	12.0	38.2
	Potassium	% K	3.5	2.0
	Sodium	% Na	1.5	2.0
	Other Bases	%	3.0	4.6
	Exchangeable Hydrogen	% H	12.0	15.0

See how this pH is constructed Ideal list on the left found on the right

Calcium (Lime)

The surface of the soil particles and humus have a negative field that attract and hold positively charged metal elements called 'CATIONS' to their surface. These elements will always SATURATE the complete surface of the soil particle, so the BASE SATURATION PERCENTS will always equal 100%.



Ca	68%
Mg	12%
K	2-5%
Na	1.5%
OB	5%
H	12%
PH	6.2

This is an ideal balance. Soil structure is good. Maximum microbial activity. Optimum availability of all elements

Calculating Ca, Mg, K and Na

We use the following figures
Ca 200
Mg 120
K 390
Na 230

There are two methods that can be used

1/ ppm and 2/ Base Saturation Percentages

Today we will use the simplar ppm method

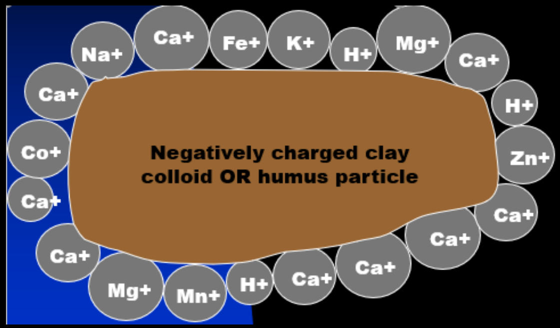
PH Chart showing H %

pH(water)	H%
4.2	61.0
4.3	59.0
4.4	57.0
4.5	55.0
4.6	53.0
4.7	51.0
4.8	49.0
4.9	47.0
5.0	44.0
5.1	42.0
5.2	39.0
5.3	36.0
5.4	33.0
5.5	30.0
5.6	27.0
5.7	24.0
5.8	21.0
5.9	18.0
6.0	15.0
6.1	13.5
6.2	12.0
6.3	10.5
6.4	9.0
6.5	7.5
6.6	6.0
6.7	4.5
6.8	3.0
6.9	1.5
7.0	0.0

PPM Method for Ca

Ca Desired

CEC x 200 = total if all exchange sites are occupied by Ca but we only need 68% to be Ca



Ca	68%
Mg	12%
K	2-5%
Na	1.5%
OB	5%
H	12%
PH	6.2

CEC x 200 x 0.68 = desired ppm

CEC x 200 x % found = found ppm

Difference x 2 = kg Ca required

Then see Ca% of available products = tn required/ha

Megan's

CEC 35.22 x 200 = 7044 x 0.68 = 4789 x 2 = 9579 x 1.123 = 10758kg/ha desired

CEC 35.22 x 200 = 7044 x 0.49 = 3451x 2 = 6903 x 1.123 = 7752kg/ha found

Def = 3006 kg of Ca/ha

Good quality lime eg 90% CaCo3 of which approx 40% is Ca so / 3006 by 400 (400kg of Ca/tn) = 7.5tn/ha of lime required

Dad’s Garden Ca

CEC 39.05 x 200 = 7810 x 0.68 x 2 = 10621 x 1.123 = 11929kg/ha desired

CEC 39.05 x 200 = 7810 x 0.79 x 2 = 12339 x 1.123 = 13857kg/ha found
Surplus = 1928 kg of Ca/ha

Good quality lime eg 90% CaCO3 of which approx 40% is Ca so / 1929 by 400 (400kg of Ca/tn) = 4.8tn/ha of lime surplus

Choosing what Ca product to use

Lime – Calcium Carbonate 39% Ca– Lime suppresses soil Mg, so evaluate Mg level in test

Dolomite – Calcium Carbonate 25% Ca, Magnesium Carbonate 11% Mg
Apply when both Ca and Mg are low or when Mg is ideal but Ca is required. In NZ soils the majority of Mg deficiency is being created by lime applications without consideration for Mg

Gypsum - Calcium Sulphate 22% Ca 18% S – Water soluble. Can be applied to provide sulphur for crops, apply to pasture when the BSP of Ca is greater than 60%

Gypsum @ 2.5tn/ha suppressing available Sel. Lambs lost use of back legs

PPM Method for Mg

Megan's soil pH 6.4

CEC 35.22 x 120 = 4226 x 0.12 = 507ppm desired x 2 = 1014 x 1.123 = 1139kg/ha desired

CEC 35.22 x 120 = 4226 x 0.333 = 1407ppm found x 2 = 2814 x 1.123 = 3161kg/ha found

Surplus = 2022 kg of Mg/ha

Surplus Mg = a wet winter hard setting summer soil. Plants will be shallow Rooted.

These soils produce sulphide gas which sterilises the soil, its also a green house gas

High Mg suppresses plant K even when soil K is in ample supply

Foliar K will give the best response

Lime/Ca will displace the surplus Mg changing the soils environment improving the soil structure and soil life

This was a high Mg soil where irrigation water used to pond.

Ca 45% Mg 36%

Calcium magnesium percentages are now

Ca 71% Mg 15%

Dad's Garden Mg

CEC 39.05 x 120 = 4608ppm x 0.12 =562ppm desired x 2 = 1129 x 1.123 = 1263kg/ha desired

CEC 39.05 x 120 = 4608ppm x 0.14 = 656ppm found x 2 = 1469 x 1.123 = 1473kg/ha found

Surplus = 210 kg of Mg/ha

Mg here is only marginally high but plant levels can be suppressed by the excess K.

Apply per 100sq metres as a foliar every 21 days
MgSO4 (Mag Sulphate) 50gms

Boron, Available as Borax 20gms (Must dissolve in hot water first)
Alternatively find a foliar product containing B

Dealing with potassium

K desired level varies with the CEC/TEC

As the CEC goes up the desired % of potassium goes down

CEC	desired %
< 5	7
< 7	6
< 10	5
< 15	4.5
< 20	4
< 25	3.5
< 30	3
< 50	2

TEC	5	10	15	20
Desired	ppm	ppm	ppm	ppm
Ca	600	1360	2040	2720
Mg	121	145.2	217.8	290.4
K	156	195	234	296.4
Na	17.25	34.5	51.75	69

PPM Method for K

Megan's soil pH 6.4

CEC 35.22 x 390 = 13736 x 0.02 = 278ppm desired x 2 = 549 x 1.123 = 617kg/ha desired

CEC 35.22 x 390 = 13736 x 0.012 = 165ppm found x 2 = 329 x 1.123 = 370kg/ha found

Def = 247kg of K/ha or a total deficiency of 500kg/ha of Sulphate of Potash – This application would be un economic so needs to be address over a period of time

But in this case the high Mg will be suppressing plant available K so we need to wait until the recommended lime is applied and Mg has been displaced.

Foliar K will give the greatest response here. I would normally recommend pasture samples to get a complete picture of what is happening.

High soil Mg can increase the incidence of lameness in stock due to [1] the hard soil [2] Increased plant stress due to shallow root systems = increased plant Nitrates

Dad's Garden K

CEC 39.05 x 390 = 15229ppm x 0.02 =304.59ppm desired x 2 = 609 x 1.123 = 648kg/ha desired

CEC 39.05 x 390 = 15229ppm x 0.63 = 959ppm found x 2 = 1919 x 1.123 = 2155kg/ha found

Surplus = 1507 kg of K/ha

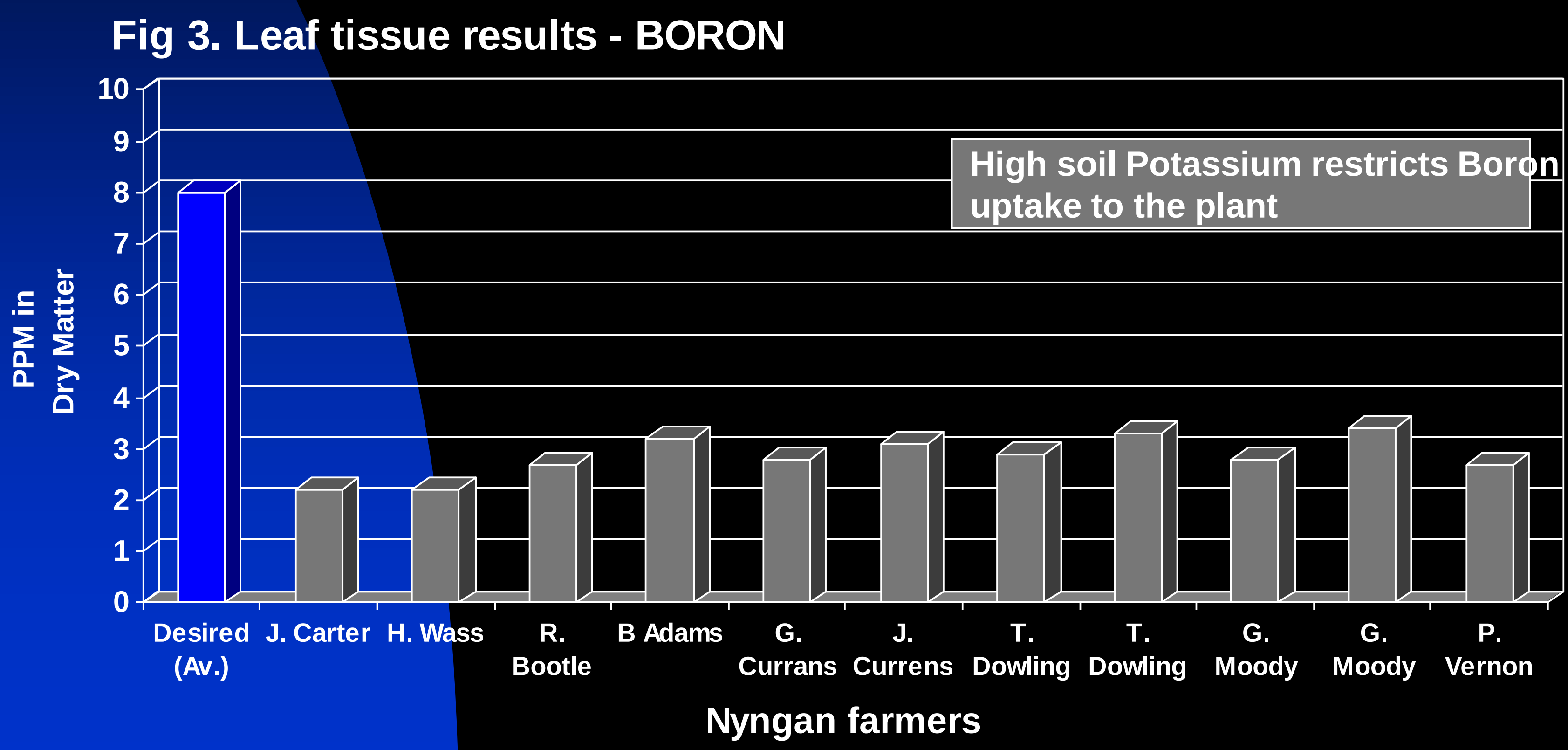
Vegetables will grow well but tend to go seed and can have a bitter taste
I recommend foliar Magnesium as high K suppresses plant Mg

Surplus K is often found in home gardens due mainly to the use of compost and animal manures

Composts are great to promote soil biology need also to be evaluated as a fertiliser

Leaf tissue results taken from Red Soil in the Trundle, Tullamore and Nyngan districts 2000

Soil high in potassium with good boron levels



	Shepparton Waste / Western Compost	Mushroom Compost / Nagambie	Frank Harney / Elmore	Biosys Agribusiness	Weekly Times Compost	Weekly Times Compost
Nitrogen (N)						
100						
Wet Tonnes required for 1 Ha	10.0	10.0	10.0	10.0	10.0	10.0
Other nutrients gained:						
Calcium (Ca)	198	396	329	45	49	72
Sulphur (S)	23	106	31	15	367	337
Nitrogen (N)	171	113	163	59	51	54
Phosphorous (P)	25	40	99	21	32	43
Potassium (K)	126	65	123	66	610	542
Boron	0	0	0	0	0	0
Zinc	2	2	2	3	1	2
0	-	-	-	-	-	-

		ppm	kg/ha
Calcium (Ca)	Desired	2071	4653
	Found	1203	2704
	Deficit	kg/ha	1949
Magnesium (Mg)	Desired	219	493
	Found	532	1195
	Deficit	kg/ha	0
Potassium (K)	Desired	208	467
	Found	659	1480
	Deficit	kg/ha	0
Sodium(Na)	Found	12	27

Base Saturation %

Ca:Mg RATIO		5.67	1.36
Calcium	% Ca	68.0	39.5
Magnesium	% Mg	12.0	29.1
Potassium	% K	3.5	11.1
Sodium	% Na	1.5	0.7
Other Bases	%	3.0	4.6
Exchangeable Hydrogen	% H	12.0	15.0

Trace elements

Def x 2 X 1.123 = Total of Element required x (100 ÷ percent of Element in product) = amount needed to be applied.

Eg. Dads sample Mn

Desired 25ppm

Found 13ppm

Def 12ppm x 2 =24 x (100/percentage of Mn in product)

MnS04 is 28% Mn, 100/28 = 3.57

24 x 3.57 = 85kg/ha of MnS04

Now decide what is an economic application

Gardeners – source a ground or foliar fertiliser containing Mn

Trace element application rates

Cobalt – 100 to 200gm/ha of cobalt sulphate(21% Co) for pasture
Boron - 150 to 200gm/ha of B, available as various products
Iron - up to 400kg/ha of Ferrous Sulphate (30% Fe) for pastures other than grazing. Applications can be dangerous for livestock. If recognised Fe deficiency in pastures or fodder crops apply Iron Chelate at recommended rates

Manganese: Low levels adversely affect crop/pasture production, high soil Ca suppresses plant Mn. The young from animals on high Ca soils can be born with bent front legs. Essential for trash decomposition. Foliar applications only on high Ca soils, can be added to soil fertilisers normal Ca soils
Copper – Copper 2.4kg/ha as copper sulphate at 10kg/ha
Zinc - Various products available -
Molybdenum – available as Sodium Molybdate. Maximum soil application 200gm/ha. Naturally increases as soil Ca increases

So once we have calculated all our requirements we need to view local fert companies product lists Organic or Conventional

Remember you may need both solid and foliar products

Superten		N	P	K	S	Mg	Ca
CODE							
10581	Superten	-	9.0	-	10.5	-	22.0
10754	Superten 5K (10% Potash superten)	-	8.1	5.0	9.5	-	19.8
10755	Superten 7K (15% Potash superten)	-	7.7	7.5	8.9	-	18.7
10757	Superten 10K (20% Potash superten)	-	7.2	10.0	8.4	-	17.6
10759	Superten 15K (30% Potash superten)	-	6.3	15.0	7.4	-	15.4
10761	Superten 25K (50% Potash superten)	-	4.5	25.0	5.3	-	11.0

Sulphurgain		N	P	K	S	Mg	Ca
CODE							
10060	Sulphurgain 15S	-	8.6	-	14.8	-	21.0
10032	Sulphurgain 20S	-	8.0	-	20.0	-	19.8
10033	Sulphurgain 30S	-	7.0	-	29.5	-	17.5
11625	Sulphurgain Pure	-	-	-	90.0	-	-

Peanuts 300% increased yield

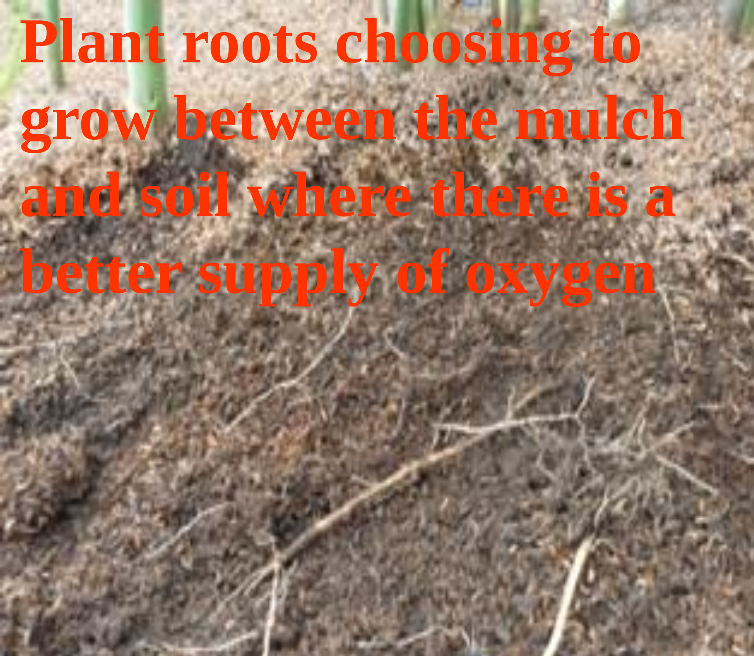
Carrots Showing Boron Deficiency

Mn def

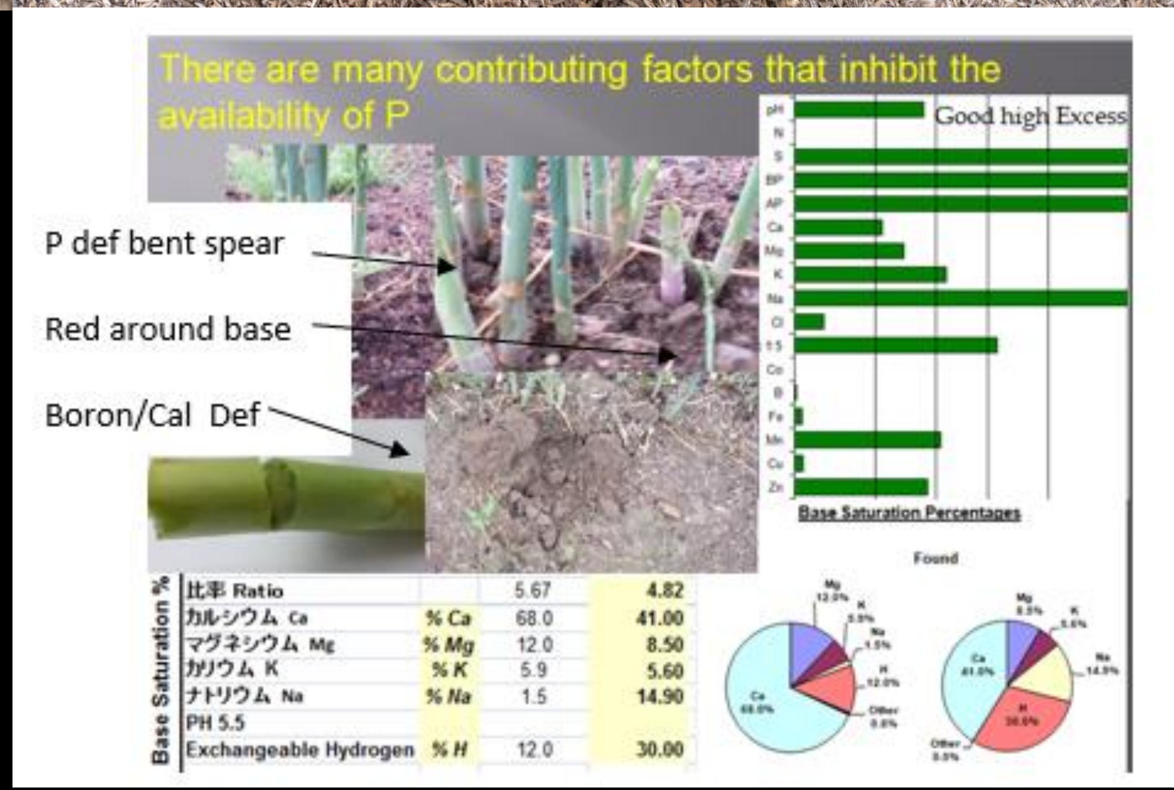
High K suppresses plant Mn

High Mg soil see shallow roots

Copper deficiency increased frost damage



mulch should be applied to a maximum depth of 50mm at any one time



比率 Ratio		5.67	4.82
カルシウム Ca	% Ca	68.0	41.00
マグネシウム Mg	% Mg	12.0	8.50
カリウム K	% K	5.9	5.60
ナトリウム Na	% Na	1.5	14.90
PH 5.5			
Exchangeable Hydrogen	% H	12.0	30.00

Side effects of over supply and poor timing of compost applications

Compost decomposition creating N deficiency reducing fruit size – timing of application is critical.

IDENTIFY YOUR SOIL TYPE

the jar test

1. Fill a clear glass jar halfway with your soil sample.
2. Fill the remaining half with water, leaving 1" of air.
3. Attach lid, then shake the jar vigorously until you have broken up any clumps of soil.
4. Set the jar aside to rest, undisturbed, overnight.

After 24 hours your jar's contents will have settled into distinct layers:

SAND **SILT** **CLAY**

By examining the proportions of these layers, you can gain a sense of what type of soil you have, and what you need to add to improve your soil. Here are some examples to use for comparison. The middle jar is ideal soil:

THE END