Association of Specialty Cut Flower Growers

Ask an ~~Expert~~ Aussie

Soil testing (and other farm hacks)

Good Hope Blooms

Acknowledgement of Country

I would like to acknowledge the Ngunnawal people, who are the traditional custodians of the land we are meeting on today, and all Aboriginal and Torres Strait Islander peoples as Australia’s First People and Traditional Custodians. We value their cultures, identities and continuing connection to country, waters, kin and community. We pay our respects to Elders past and present and are committed to the continuation of the cultural and spiritual agricultural practices of Aboriginal and Torres Strait Islander peoples.

How Indigenous Knowledge and Culture can Save the World

Respect (gut)

Connect (heart)

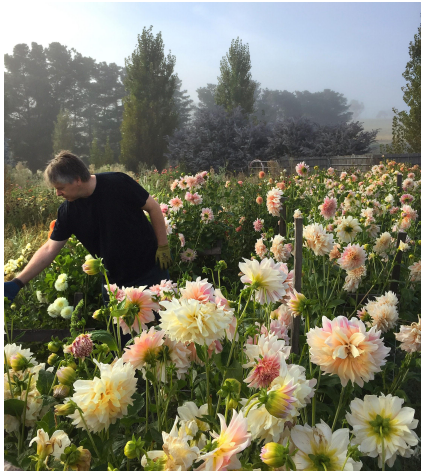
Reflect (head)

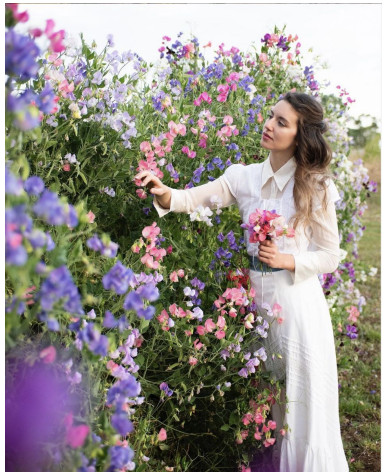
Direct (hands)

Sand Talk by Tyson Yunkaporta

Background

20 acre farm in the Yass Valley NSW
¾ acre in flower production
⅔ Annuals ⅓ Perennials
Peonies, snapdragons, lisianthus, ranunculus, dahlias, zinnias
Organic/biodynamic (not certified)
Use a lot of grass hay mulches
Season runs from Oct - April



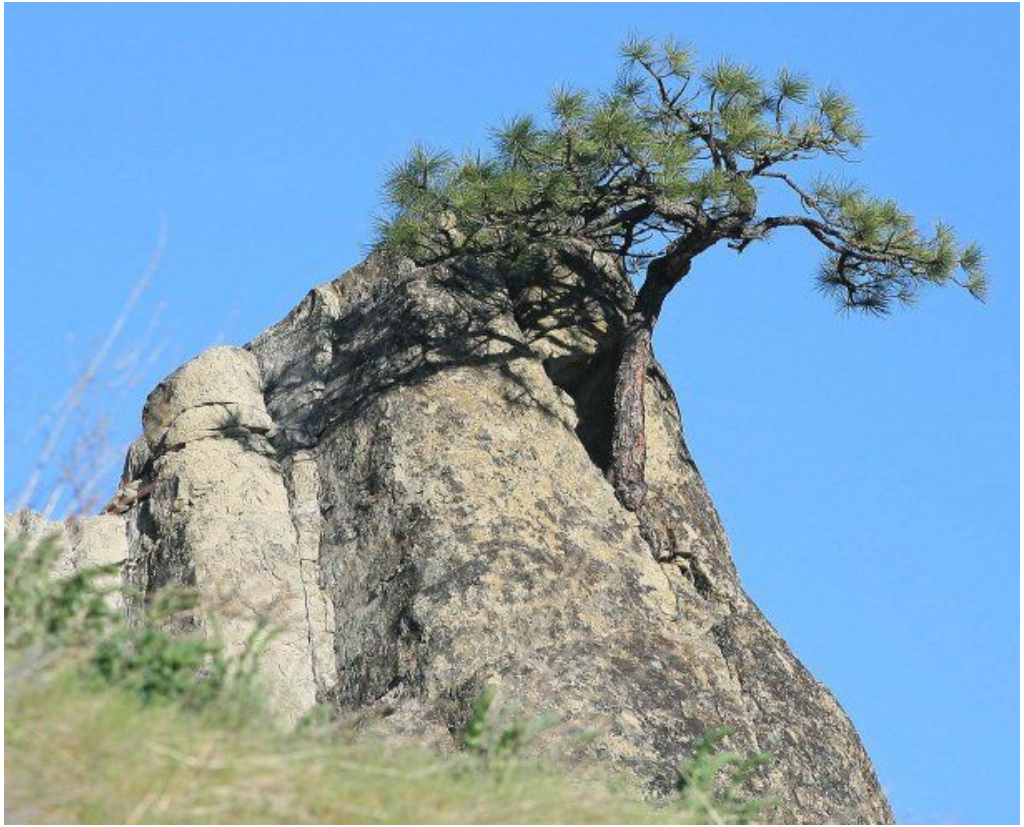


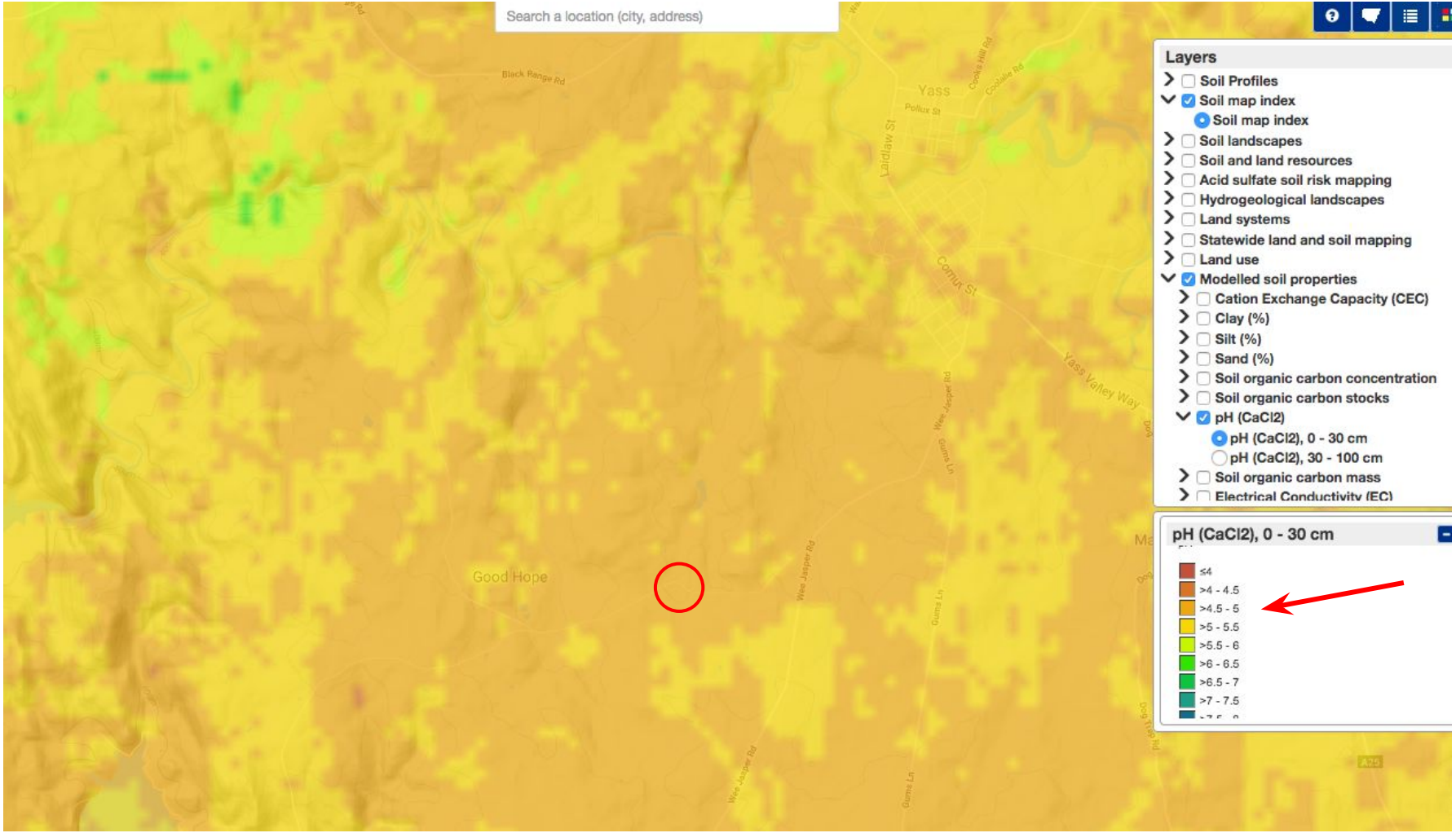
40 miles North of Canberra
Sheep and cattle area
26” average rain per year
US Zone 8B
Av temps range from -5 to +40 C
Major rains sometimes in summer and sometimes in winter and lots of wind, especially hot summer winds.


Map
Google

Drought
2017 - 2020

Soils




Search a location (city, address)
Layers
Soil Profiles
Soil map index
Soil map index
Soil landscapes
Soil and land resources
Acid sulfate soil risk mapping
Hydrogeological landscapes
Land systems
Statewide land and soil mapping
Land use
Modelled soil properties
Cation Exchange Capacity (CEC)
Clay (%)
Silt (%)
Sand (%)
Soil organic carbon concentration
Soil organic carbon stocks
pH (CaCl2)
pH (CaCl2), 0 - 30 cm
pH (CaCl2), 30 - 100 cm
Soil organic carbon mass
Electrical Conductivity (EC)
pH (CaCl2), 0 - 30 cm
≤4
>4 - 4.5
>4.5 - 5
>5 - 5.5
>5.5 - 6
>6 - 6.5
>6.5 - 7
>7 - 7.5
Yass
Good Hope
Black Range Rd
Laidlaw St
Comur St
Yass Valley Way
Wee Jasper Rd
Gums Ln
Cooke Hill Rd
Coolalie Rd
Pollux St
Cog Tree Rd
A29

Soil Testing

Soil sample from paddock beside flowers

No amendments except biodynamic preps

Crop: field grasses and clover for hay making

Soil sample from established row approx 20m (65ft) from previous sample.

Amendments added every year

Ag lime (calcium carbonate) added for first few years. Only gypsum now.

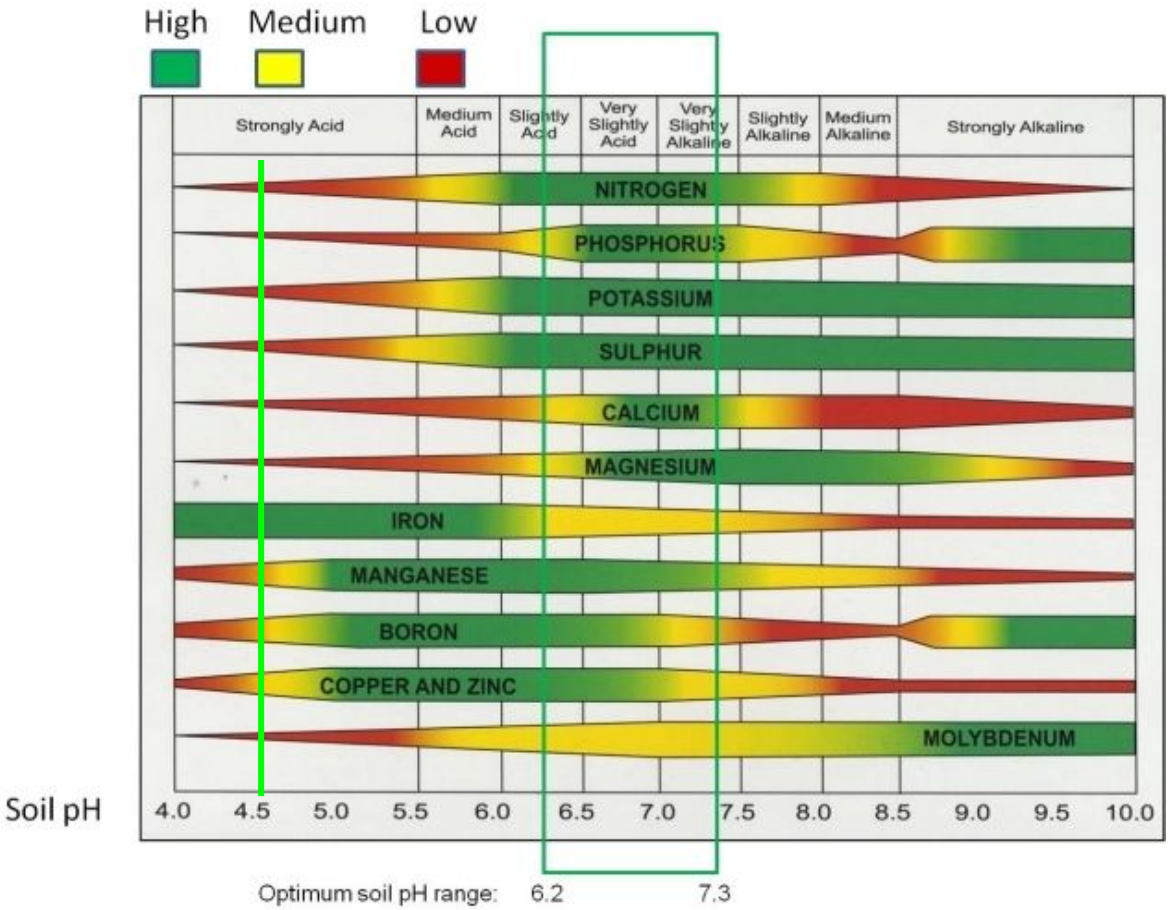
Crop: Annual cut flowers

Test new areas, or when problems appear (pest/disease)

Rather than reach for the sprayer to deal with a pest it might be better to reflect on what's wrong with my soil that's allowing the pest to damage my plants.

Every year as our soils continually improve in biological activity we have fewer and fewer problems with pests and disease.

How soil pH affects availability of plant nutrients



From above to below with no amendments after the drought pH4.5

Assessing Soil Texture

Helps determine the ability of the soil to hold nutrients and water

I did this test a few times and the average length of the ribbon on breaking was 1.5"

In this test neither grittiness or smoothness predominates. This suggests a clay/loam

This is a soil sample from a property 100 miles north of us. The ribbon broke less than 1".

This test was very gritty. This suggests a sandy/loam.

Water Infiltration Test

Measures the ability of your soil to absorb rainfall or irrigation. Stored moisture is good for plants and soil biology. Water that runs off the soil surface can lead to soil erosion. Plenty of online resources for calculating infiltration rates.

At our farm:
In rows average of 2" in the first 4 mins
In pathways under mulch 2" in 6 mins
In open paddock 2" in 26 mins

Infiltration rates will slow down as more water is absorbed and the soil becomes saturated.

Example - if you use landscape fabric on your rows and your water infiltration is low you lose all the benefits of rainfall plus gain erosion problems from water runoff.

Water Infiltration Test

Use organic mulches as a protective barrier that slows down water movement

Organic mulches (chunky like straw) encourage worms and worm tunnels provide pathways for wate and air to enter the soil

Good soil aggregation (when soil particles clump together through the action of glomalin) increases water absorbency and air infiltration.

Gypsum can also improve aggregation.

Straight compost and dry slaking soils tend to become hydrophobic and resist water.

Form flower beds on or near the contour so that water soaks into beds from pathways rather than running along them causing erosion.

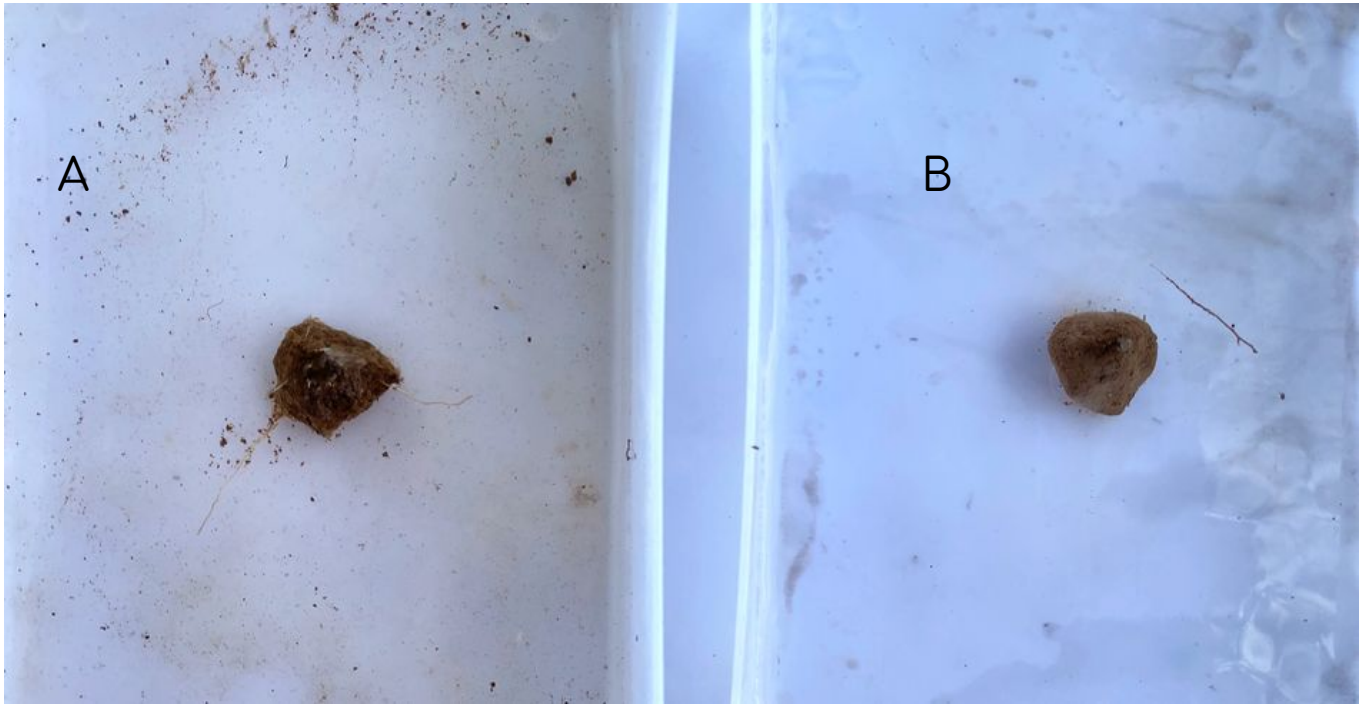
Always think...
will what I am doing impair or improve water infiltration?

Respect
Connect
Reflect
Direct

Dispersive Soils Test

Tests what happens to soils when they get wet. Ideal soils will absorb water but not change their structure - this is called aggregate stability. Test a number of samples.

This test can be used to see if gypsum will work to stabilise soils.

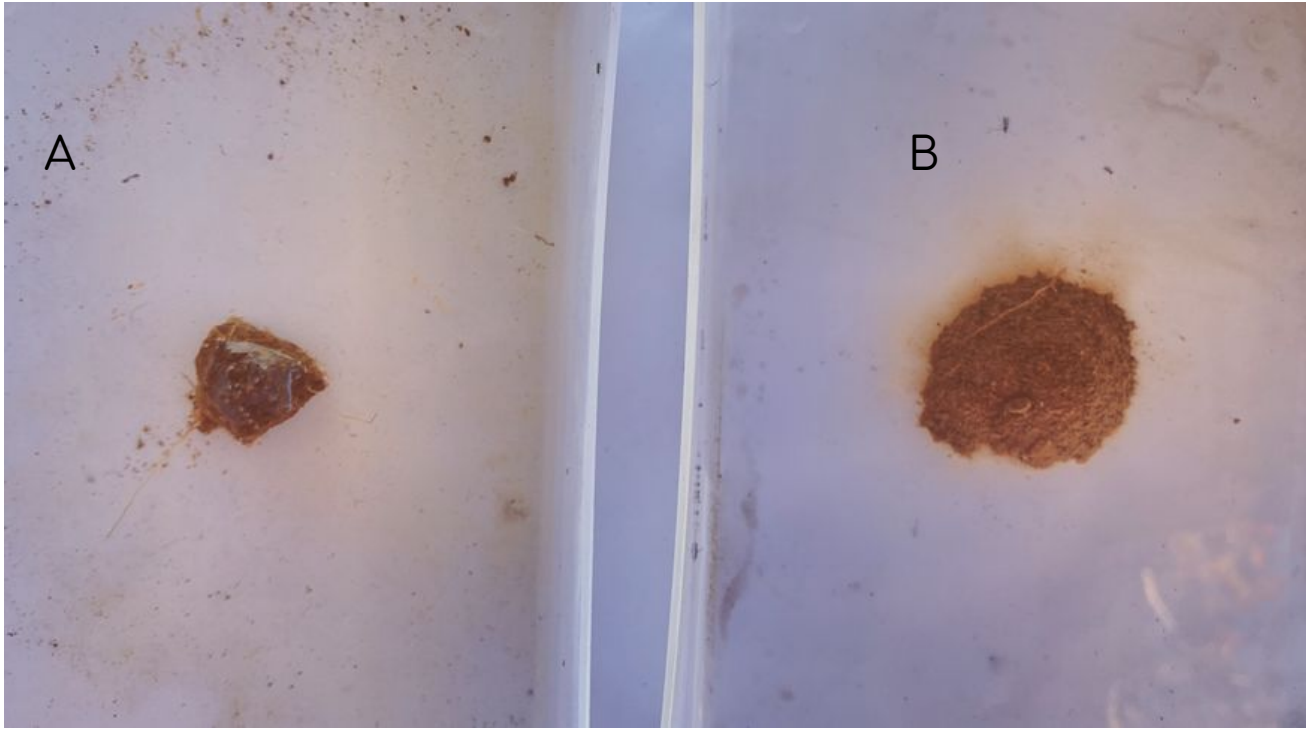


Sample from grass paddock. No amendments only biodynamic preps

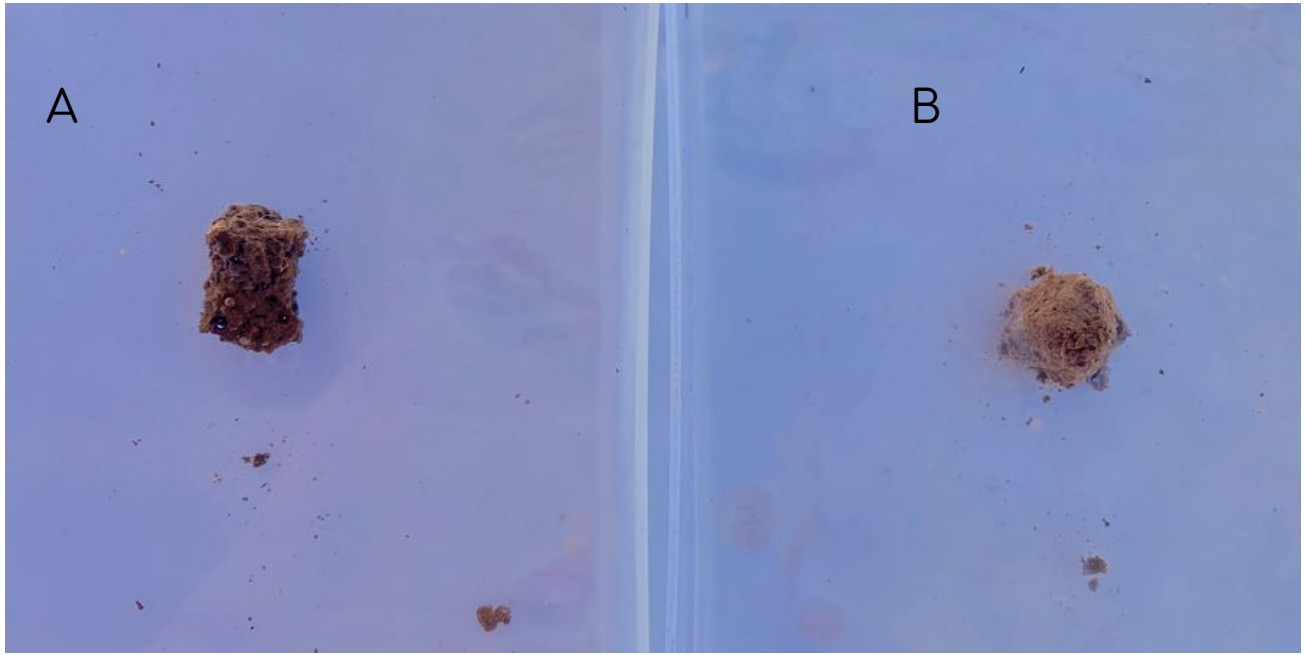
Dispersive Soils Test

24 hours later

Wet sample B has slaked (lost its structure) and has a slight halo (clay moving into the water). Most of the slaked aggregates are small.



Dispersive Soils Test

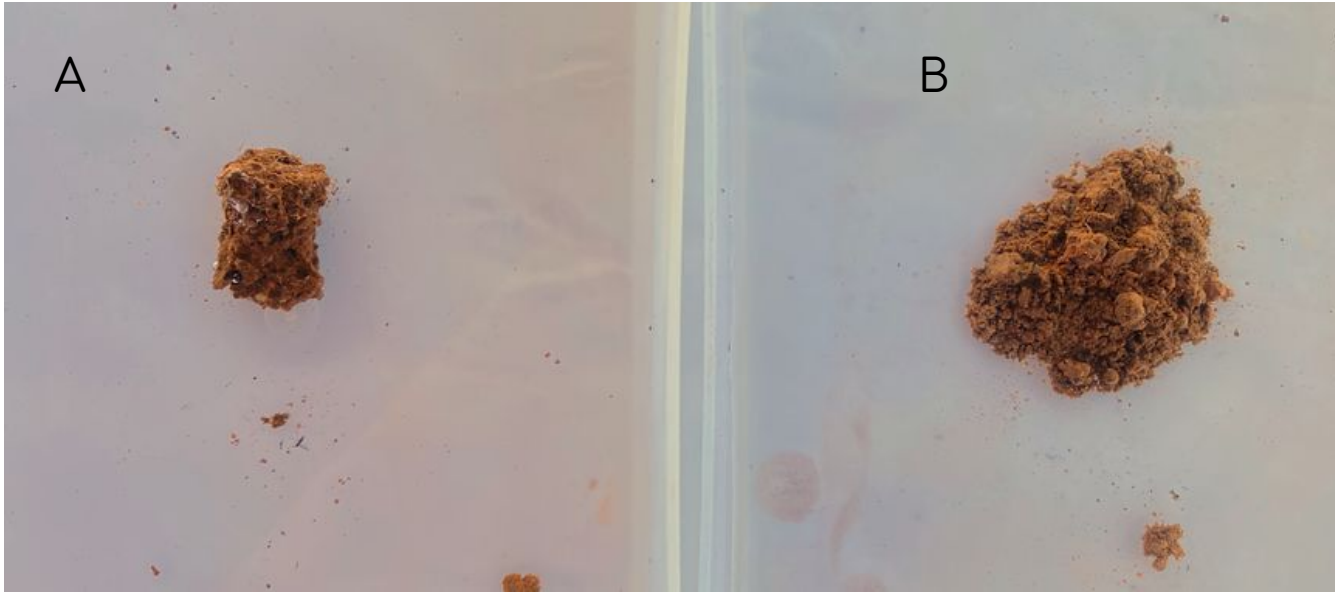


Test from one of the flower rows

Dispersive Soils Test

24 hours later.
Some slaking in wet sample but the aggregates have stayed large. No evidence of dispersion.

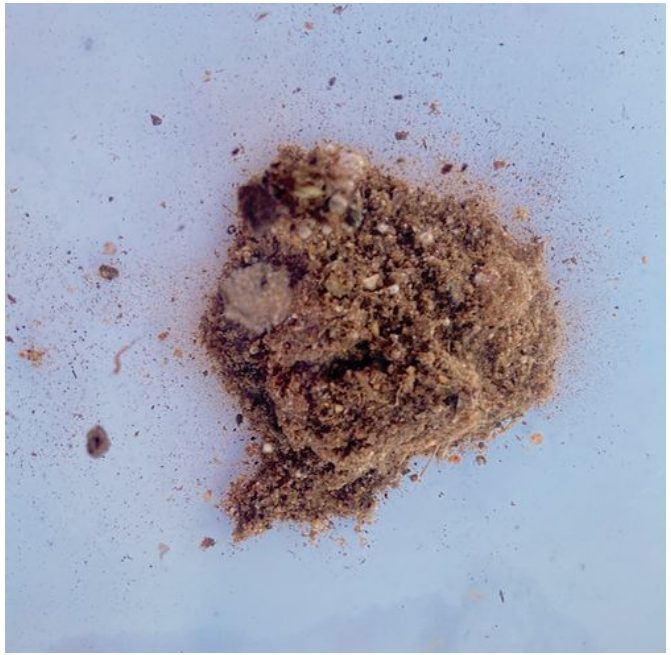
Addition of organic matter and gypsum has improved aggregate stability in our rows.



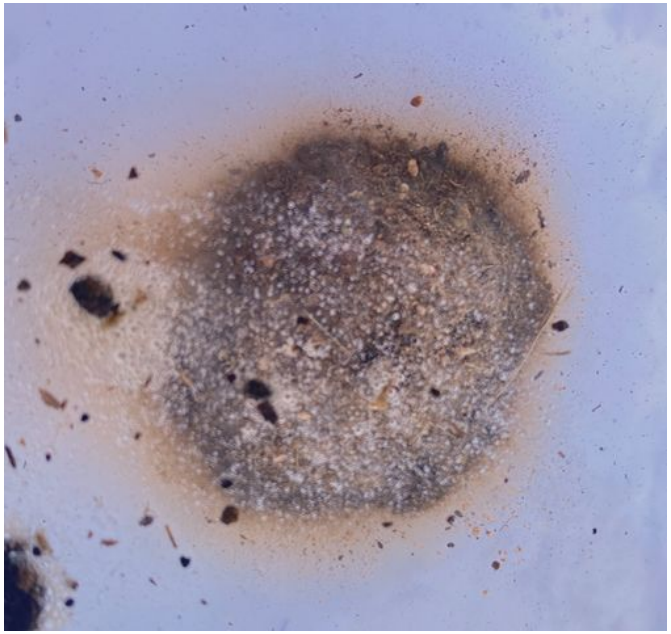
Dispersive Soils Test

Different sample not from our farm immediately slaked in both samples and large halo

C



D



DISCLAIMER: The following results and amendments are for the soil sample tested on our farm and can't be used as a basis for corrections in other soils in other places.

Soil test parameters can be 60 - 80 years old and based on conventional chemical agriculture. Some are Albrecht some are not eg the Haney test.

Soil test results vary according to time of year, moisture content, recent practices, temperature, and the lab you use. Send samples to two or more labs and you will get different results.

Lab results don't account for biological activity, they measure chemistry.

Soils are dynamic and constantly changing.

How we test, may change significantly in the next decade. (eg. sap testing)

Lab Soils Test

Sampling with stainless steel apple corer. Measure the soil profile you want to test. Usually top 6". Lab will recommend how to sample.

Push in twice to get extra depth.

Sample across field

ITEMS			RESULTS	DESIRABLE LEVEL		
				SNAPDRAGONS	SWEET PEAS	RANUNCULUS
pH(1:5 Water)†			7.3	5.0-6.5	6.0-7.5	6.0-7.5
pH(1:5 0.01M $CaCl_2$)†			6.8			
Electrical Conductivity†	EC	µS/cm	235	< 315	< 470	< 315
TOTAL SOLUBLE SALT	TSS	ppm	775.5	< 1040	< 1551	< 1040
AVAILABLE CALCIUM†	Ca	ppm	2300	2490	2490	2490
AVAILABLE MAGNESIUM†	Mg	ppm	546	368	368	368
AVAILABLE SODIUM†	Na	ppm	92	< 235	< 235	< 235
AVAILABLE NITROGEN	N	ppm	19.5	16	32	54
AVAILABLE PHOSPHORUS†	P	ppm	88.1	40	70	90
AVAILABLE POTASSIUM†	K	ppm	385.71	256	341	341
AVAILABLE SULPHUR†	S	ppm	41	11 - 15	11 - 15	11 - 15
AVAILABLE COPPER†	Cu	ppm	6.8	3	3	2
AVAILABLE ZINC†	Zn	ppm	21.9	5-7	5-7	7
AVAILABLE IRON†	Fe	ppm	8	> 30	> 30	> 30
AVAILABLE MANGANESE†	Mn	ppm	69	> 20	> 20	> 20
AVAILABLE COBALT	Co	ppm	5.12	=> 1.0	=> 1.0	=> 1.0
AVAILABLE MOLYBDENUM	Mo	ppm	0.4	> 0.5	> 0.5	> 0.5
AVAILABLE BORON†	B	ppm	0.63	1.0-1.5	1.0-1.5	0.6-1.0
TOTAL ORGANIC MATTER†	OM	%	7.85	6 - 10	6 - 10	6 - 10
TOTAL ORGANIC CARBON†	OC	%	3.93	3 - 5	3 - 5	3 - 5

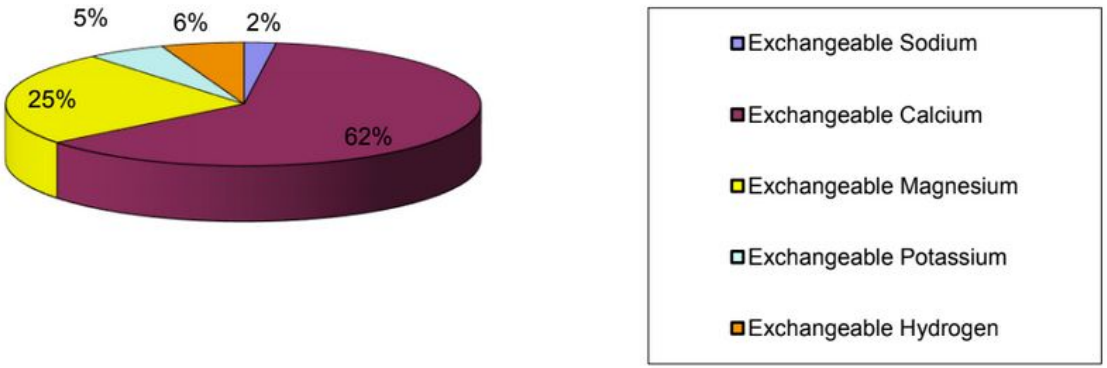
Original 3.8 ppm

FILE NO : 2102157735 **LANDUSE:** SNAPDRAGONS

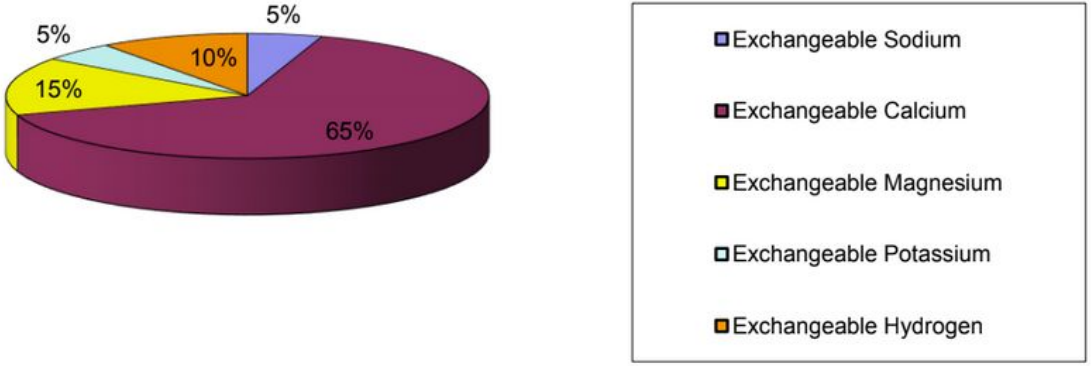
ITEMS			RESULTS	DESIRABLE LEVEL
EXCHANGEABLE CALCIUM	Ca	meq/100 of soil	10	10.5
EXCHANGEABLE MAGNESIUM	Mg	meq/100 of soil	3.98	2.42
EXCHANGEABLE SODIUM	Na	meq/100 of soil	0.349	< 0.805
EXCHANGEABLE POTASSIUM	K	meq/100 of soil	0.864	0.805
EXCHANGEABLE HYDROGEN	H	meq/100 of soil	3.02	
ADJ. EXCHANG. HYDROGEN	H	meq/100 of soil	0.91	< 2.42
CATION EXCHANGE CAPACITY	CEC	meq/100 of soil	18.2	
ADJUSTED CEC	Adj.CEC	meq/100 of soil	16.1	
EXCH. SODIUM PERCENTAGE	ESP		1.92	< 5
CALCIUM / MAGNESIUM RATIO	Ca/Mg		2.53	2 - 4
BASE SATURATION PERCENTAGE	BSP		85	

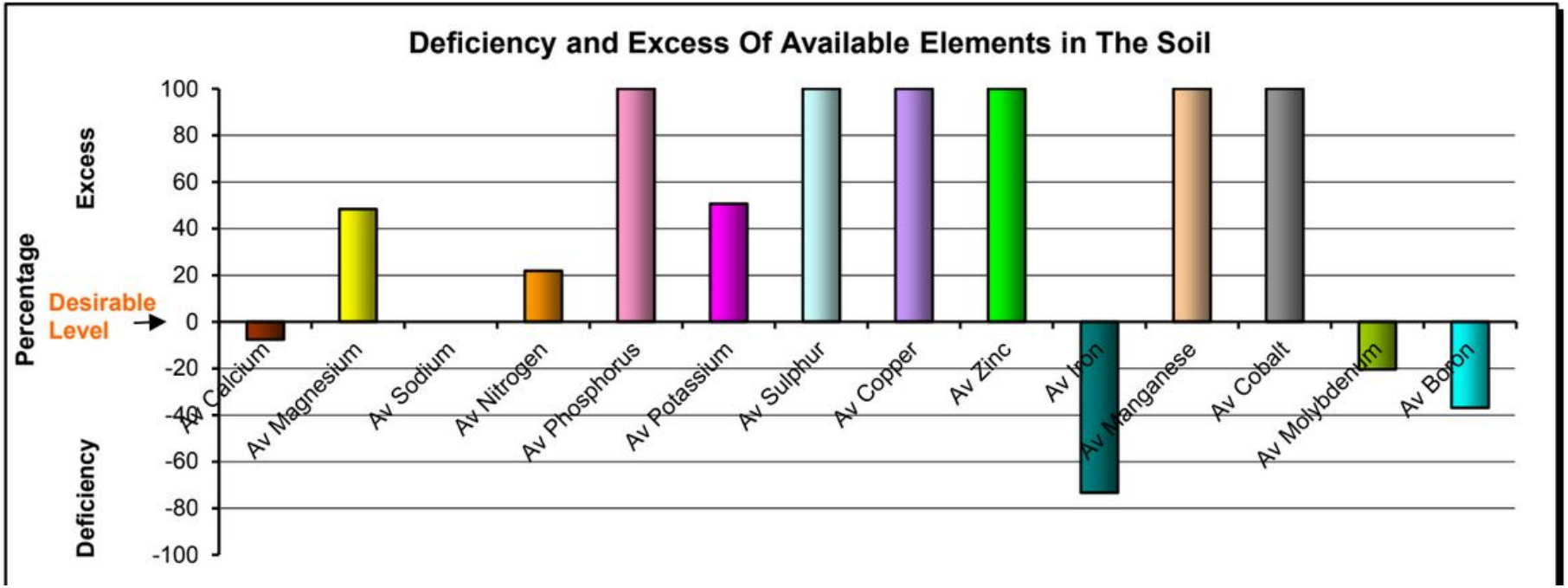
ITEMS		PERCENTAGE OF ADJUSTED CEC	DESIRABLE LEVEL
EXCHANGEABLE CALCIUM	Ca	62.1	65-70%
EXCHANGEABLE MAGNESIUM	Mg	24.7	12-15%
EXCHANGEABLE SODIUM	Na	2.2	0.5-5%
EXCHANGEABLE POTASSIUM	K	5.4	3-5%
EXCHANGEABLE HYDROGEN	H	5.6	<20%

Actual Exchangeable Cation Percentage

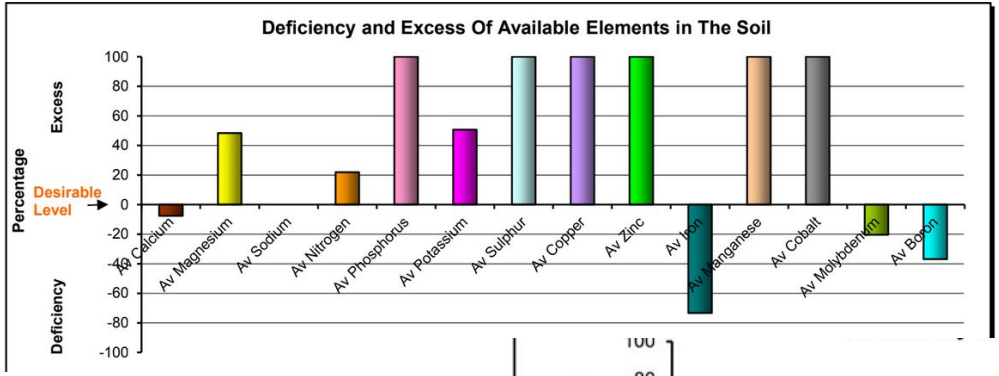


Desirable Exchangeable Cation Percentage



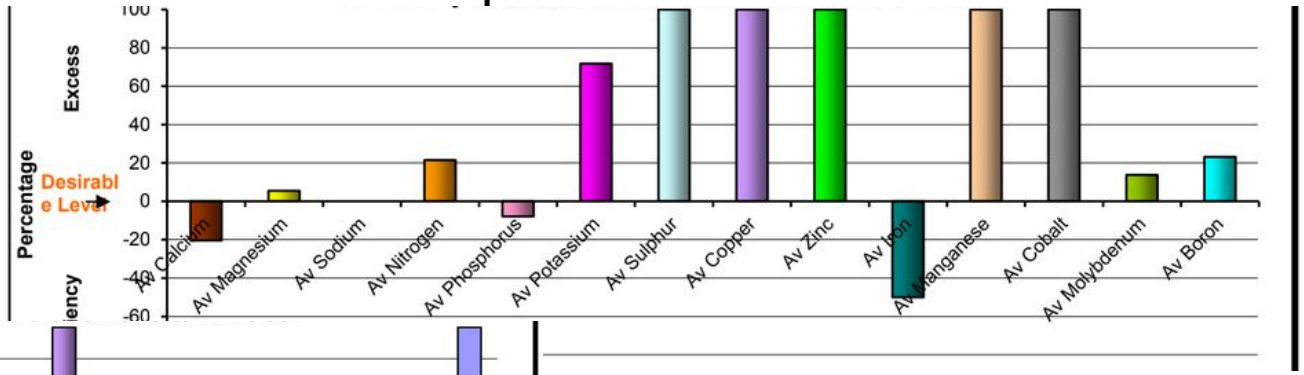


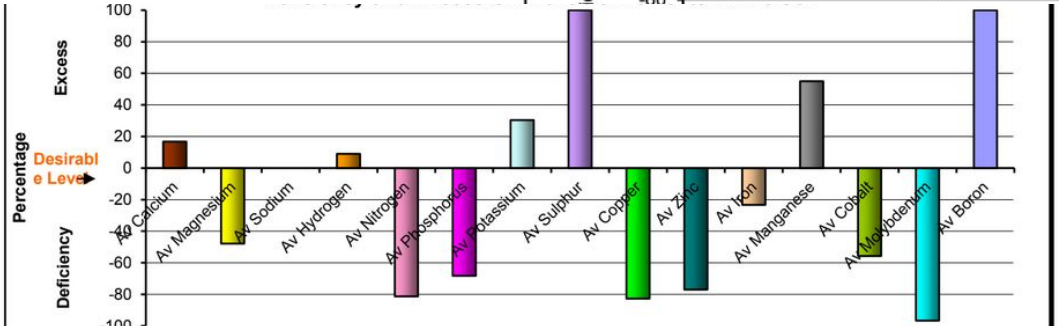
Excesses can be just as harmful as deficiencies. Heavy use of composts can drive excesses. Biological activity increases as a result of compost may help to reduce the effects of excess nutrients.



2021

2020





2017

Excess nitrogen can lead to reduced pest and disease resistance and can pollute waterways and groundwater.

Excess phosphorus is easily leached and can pollute waterways and groundwater. Also ties up zinc.

Excess magnesium will “tighten” soils making them harder to work and slower to infiltrate water.

Manganese and boron are toxic to plants at high levels.

Excess molybdenum reduces copper availability (important for pastures when grazing)

Excess iron ties up phosphorus

GYPSUM REQUIREMENT	3	t/ha
LIME REQUIREMENT	0	t/ha
DOLOMITE REQUIREMENT	0	t/ha

TOTAL FERTILISER REQUIREMENT (kg/ha)	N	P	K	S	Ca
SNAPDRAGONS	6	0	0	0	0
SWEET PEAS	11	0	0	0	0
RANUNCULUS	86	5	0	0	0

with Trace Elements:

	SNAPDRAGONS	SWEET PEAS	RANUNCULUS	
COPPER	0	0	0	kg/ha
ZINC	0	0	0	kg/ha
COBALT	0	0	0	kg/ha
MOLYBDENUM	0.05	0.05	0.05	kg/ha
IRON	4.5	4.5	4.5	kg/ha
MANGANESE	0	0	0	kg/ha
BORON	1.125	1.125	1.125	kg/ha

- Gypsum Requirement is to increase the Calcium and Sulphur and decrease the Exchangeable Sodium and or the Exchangeable Magnesium in the soil. Gypsum Requirement is based on 18.6% Sulphur and 23.5% Calcium

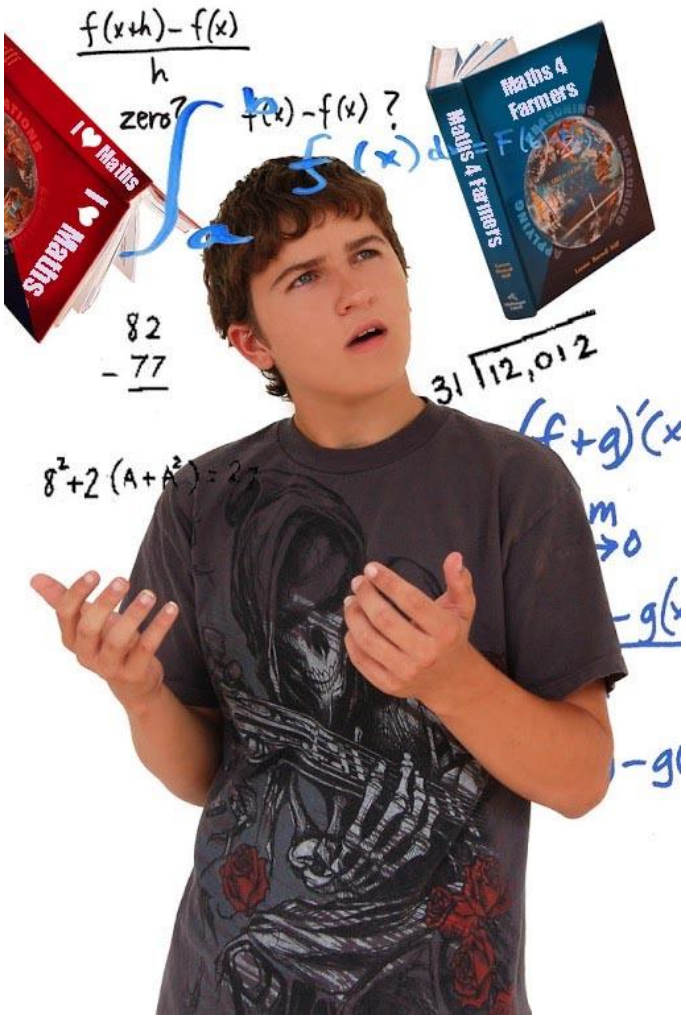
Does the maths applying to soil tests really confuse you?

If you answer yes you are probably in the majority!

Solutions probably won’t just be in a bottle.

The following is a breakdown of the maths needed to work out the application rate per row from your soil report.

Another disclaimer: I’m a media arts teacher, not a maths teacher!



Mathematics time!

Gypsum requirement *3 tonnes to 1 hectare*

1 hectare = 10,000 sq metres

1 row at our farm is approximately 17 sq metres

10,000 divided by 17 = approx 588 rows

3 tonnes = 3,000 kg

3,000 divided by 588 = approx 5kg

So 5kg of gypsum is needed per row

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So lets do this in Imperial!

Gypsum requirement ***1.36 tons to 1 Acre***

1 acre = 43,560 sq ft

1 row at our farm is approximately 184 sq ft (width x length)

43,560 divided by 184 = approx 237 rows

1.36 tons = 2,720 lb

2,720 divided by 237 = approx 11.5 lb

So 11.5 lb of gypsum is needed per row

(11.5 lb is equivalent to 5.2kg)

Sweet Peas Nitrogen Requirement 11kg/hectare

We already know that on our farm 588 rows = 1 hectare

Decide nitrogen source - blood/feathermeal mix 14% nitrogen

11kg = 11,000 grams

11,000 divided by 588 = approx 19 grams of nitrogen per row

Our nitrogen source is only 14% so we need to:

Divide 19 by 0.14 = 135 grams of the bagged mix per row

The recommendation is for the growing season. Don't apply all at the start. Because of our use of composts and hay mulch, nitrogen is the one recommendation we adhere to the least. The nitrogen recommended on your report won't allow for the nitrogen fixing bacteria present or any prior nitrogen fixing crop.

Boron Requirement 1.125kg/hectare

We already know that on our farm 588 rows = 1 hectare

Decide boron source - Borax is approx 11% boron

1.125kg = 1,125 grams

1,125 divided by 588 = approx 2 grams per row

Our boron source is only 11% so we need to:

Divide 2 by 0.11 = 18 grams of borax per row

When measuring small amounts, measure say 100 grams on a digital kitchen scale and measure how many tablespoons that amount is. Then you will have a weight per tablespoon.

Outliers - beware

TOTAL FERTILISER REQUIREMENT (kg/ha)	N	P	K	S	Ca
SNAPDRAGONS	6	0	0	0	0
SWEET PEAS	11	0	0	0	0
RANUNCULUS	86	5	0	0	0

Outliers - beware (trust your gut)

	N	P	K	Mg	S	B	
Annuals	2.5	1.5	0	0	0.34	0.50	Feb 17
Perennials	2.5	1.5	0	0	0.34	0.01	

AVAILABLE BORON[1]	B	ppm	5.64	Sep 17
AVAILABLE BORON[†]	B	ppm	0.63	Feb 21

Hints and Tips

Use the same lab every year ($120 - $220AUD per test in Australia)

This is soil chemistry not biology. There are a billion plus organisms in a handful of soil and we have no idea what most of them do or their interactions. They are incredibly important.

Recommendations are site specific. Results vary within feet so don't judge by neighbours soil test.

Test in Autumn/Fall and make lime amendments then. If you can't incorporate the lime (eg. no-till) then wait until spring for others.

Avoid excess nutrients

Hints and Tips

Sulphur readily leaches from soil with rainfall and can be used to remove excesses of things like magnesium.

Foliar applications of minerals can work well if there are tie up issues in the soil. Use brix analysis (more on this later) to test if working.

Tunnels are tricky as they don't receive rainfall.

Test for total levels - did this for phosphorus last year and had +1000ppm in "storage".

There are MAXIMUM yearly application rates for each.

Can use bioaccumulating plants to incorporate or mulch/compost.

Hints and Tips

Check organic certifier to see what amendments you can use if you are certified (eg. USDA).

Some minerals work best when in balance with others eg 2:1 iron to manganese, no higher than 10:1 phosphorus to zinc, etc.

If foliar spraying mix with fulvic acid for better plant take up.

We are cycling carbon through our plants and we can maximise this by having minerals and biology working together.

Remember, I'm an Aussie not an expert, so test and trial to make sure you are confident before applying major changes to your soil.

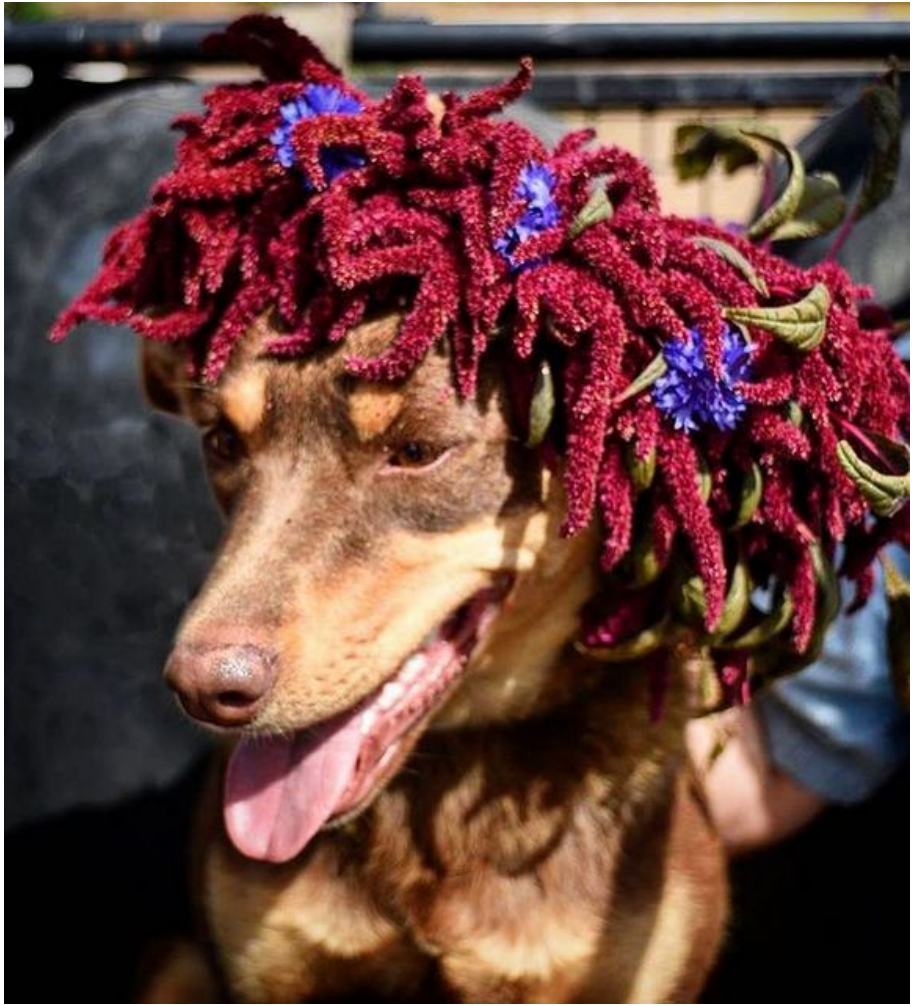
Hints and Tips

Two super resources are:

Jennie Love and Ellen Polishuk - Soil testing demystified
https://linktr.ee/Notillflowers

Dan Kittredge series on
Living Web Farms YouTube Channel
https://youtu.be/im42xjLEk3A

Dan goes through the maths in much more detail and gives figures on maximum application rates



Reading references for soils

Natural Farming: A practical guide by Pat Coleby (Australian)

Call of the Reed Warbler by Charles Massy (Australian)

Advancing Biological Farming: Practicing Mineralized, Balanced Agriculture to Improve Soil & Crops by Gary Zimmer and Leilani Zimmer-Durand

For the love of soil by Nicole Masters

Growing a revolution by David Montgomery

Listening references for soils

Nutrition Farming by Graeme Sait (Australian)

The No-till Market Garden Podcast by Farmer Jessie

The No-till Flowers Podcast by Jennie Love

The regenerative agriculture podcast by John Kempf

Tractor Time by Acres USA

In Search of Soil by Diego Footer

Further resources

YouTube

Living Web Farms

Charles Dowding

Bare Mountain Farms

Anything with Gabe Brown or Ray Archuleta in it!

Podcasts

The regenerative journey with Charlie Arnott

The Regen Narration

Bare Mountain Farms

Books

Sand Talk by Tyson Yunkaporta

The New Organic Grower by Eliot Coleman

Water for Every Farm - P. A. Yoemans

Cool Flowers by Lisa Mason Ziegler