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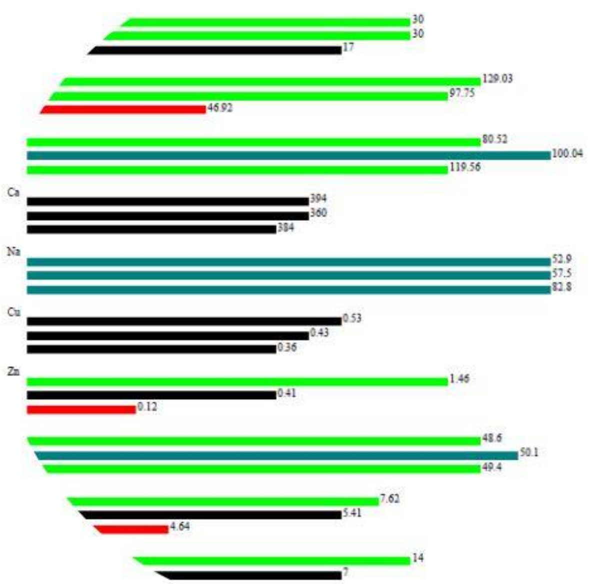
SOIL, WATER AND PLANT TISSUE TESTING AND MONITORING FOR CROP AND LIVESTOCK NUTRITION, ENVIRONMENTAL HEALTH AND HEALTHY COMMUNITIES.

PRODUCER SOIL TEST INTERPRETATION GUIDE:

Interpretation of lab data, graphical results, and fertiliser considerations for nutrition programs.



ABSTRACT

The graph interpretation is an easy visual assessment of soil and leaf analysis data. The graph module, being presented in color provides a quick overview of the main problem areas. At the same time leaf analysis from the selected site can be displayed on the same form, so that a direct assessment of soil reaction to plant indication can be carried out along with comparisons of depths, paddocks, or sites.

Joy Sherlock

Valle Agribusiness and Environmental Services

VALLE AGRIBUSINESS &
ENVIRONMENTAL SERVICES

Contents

Contact: Joy Sherlock
Phone: 040 075 1614
Email: vaes@live.com.au
PO Box 211, Dongara, WA, 6525
www.vaes.com.au

SOIL TEST INTERPRETATION GUIDE:

The graph interpretation is an easy visual assessment of soil and leaf analysis data. The graph module, being presented in colour provides a quick overview of the main problem areas. At the same time leaf analysis from the selected site will/can be displayed on the same form, so that a direct assessment of soil reaction to plant indication along with comparisons of depths, paddocks or sites can be carried out.

The colour, as well as the actual length of the graphs indicate the very low (red), the marginal (black), the optimum (green) and the very high (blue) levels based on the laboratory's determination.

The program is responsive to soil types. For this reason, you may find that a Potash concentration of 80 may be adequate for a sand, whereas the same concentration may be deficient for a clay. Since the soil is not a stable medium, it is important to monitor nutrient changes influenced by seasonal conditions, by cultivation practices or various soil improvement activities, such as liming, the use of Gypsum or Dolomite.

Due to advancing technology analytical methods as adopted by various Laboratories may vary considerably. This does present problems in the evaluation of and interpretation of the data if the methods are not known, or if data from various laboratories are compared.

Local conditions, crop requirements and past practices must be considered. Soil types and changes to the natural characteristic through cultivation and fertilizer practices as well as the pH influence can distort the standards used.

Very high concentrations of one or more elements and the possible antagonistic reaction can only be evaluated by combining a soil and leaf test.

The evaluation of the main as well as trace element concentrations is valid on the lower scale. However due to imbalances and cultural practices (no till, plant population, herbicide use etc), plants can show specific deficiencies even at normal to high soil values.

Contact: Joy Sherlock
Phone: 040 075 1614
Email: vaes@live.com.au
PO Box 211, Dongara, WA, 6525
www.vaes.com.au

Excessive applications of fertiliser including liming materials often create greater problems than low rates. Using a shotgun mix also can contribute to creating imbalances. Examples of antagonistic reactions may be excessive Manganese can affect uptake of Phosphorous held in the system, imbalance in Ca:Mg ratio increases the effect of salinity and Aluminium issues.

The results as per analysis is an indication only of the nutrient status and character of your soil at time of collection. Climatic influences, such as rain, heat, cold, cultural practices, no-till etc can alter the actual levels between now and seeding. However, the base character should remain the same. To assist in the understanding of the analytical data, several calculations and indicators are used to highlight specific problems.

pH: Indicates the intensity of the soil acidity or alkalinity. The pH is a reaction and can be influenced by several factors, low Calcium, high Sodium, Magnesium and soil character, structure, and poor soil' aeration (compaction). The pH does not indicate the Calcium in the soil. pH (H20) of between 4.5 – 6.5 is acceptable if good soil health including biology is present.

pH (CaC12) is often used as there may be less variation however pH (H20) best represents what is occurring in the soil and plants. If analysis is done using pH (CaCl2) it can be converted using the table below:

pH 1:5 CaCl	Average deviation factor converts to	**pH 1:5 H2O**
7.3 - 7.8	+0.5	7.8 - 8.3
6.6 - 7.2	+0.4	7.0 - 7.6
6.0 - 6.5	+0.5	6.5 - 7.0
5.4 - 5.9	+0.6	6.0 - 6.5
4.4 - 5.3	+0.7	5.1 - 6.0
4.1 - 4.3	+0.8	4.9 - 6.0
3.8 - 4.0	+0.9	4.7 - 4.0
Below 3.7	+1.0	4.7

Conductivity, converted to Total Soluble Salts (TSS): An indicator as to the status of Salt. This again can be influenced by several soil related factors, not only Sodium and Chloride.

TSS = Conductivity amount x 3000

Contact: Joy Sherlock
Phone: 040 075 1614
Email: vaes@live.com.au
PO Box 211, Dongara, WA, 6525
www.vaes.com.au

The actual nutrient concentrations: The various methods used to determine the present levels of soil elements, indicates the plant available proportion of soil minerals in ppm or mg/kg. Under most conditions, this represents between 5 and 10% of the
total soil mineral reserves. As a guide, based on a topsoil of 10 cm, 1 ppm equals approximately 1 kg/ha of the element as per analysis. If a measurement of the top 15 cm was taken, then it would equal to 1.5kg/ha of the element as per analysis.
These minerals are influenced by specific soil reactions, especially the plant available proportion. As such they can not be seen as absolute. They are influenced by the soil character, pH, Salt, and imbalances. Cultivation or no till also plays a role.

0 – 100mm (10cm) = 1,000,000 kg of dry soil per hectare (therefore ppm = kg per hectare…P = 50 ppm is equivalent to 50kg of P over one hectare at a depth of 100mm).

For example, Phosphate: Concentrations of P exceeding 40 ppm under normal Western Australian soil and climatic conditions usually can indicate a problem relating to P mobility as far as plant availability is concerned. Several factors can influence this: acid soils, low concentrations of Magnesium, the interaction of the trace elements, especially Zinc and Manganese.

Colwell Phosphorous is used however be mindful that soluble P can be measured by Olsen, Colwell, Brae, and Mehlich-3 analysis methods and all will give different readings.

Total P is taken into considerations when using soil microbiology to make P available to plants.

PBI Index – Phosphorous Buffering Index in general 80-100 is good enough. PBI is used in conjunction with the Colwell Phosphorus measurement and gives an interpretation of a soils ability to “lock-up” P. Soils with a high PBI will quickly bind P to “exchange sites” and make it unavailable for plant uptake. Conversely, soils with a low PBI will lock up only small amounts of P, leaving the majority of fertiliser applied P available for plant uptake. Managing high PBI soils generally involves applying higher rates of P fertiliser. Doing this over many years will gradually fill more and more exchange sites, therefore leaving more fertiliser P available for the growing crop. In some Australian soils, where PBI is particularly low, phosphorus leaching can occur.

Contact: Joy Sherlock
Phone: 040 075 1614
Email: vaes@live.com.au
PO Box 211, Dongara, WA, 6525
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PBI Category	Classification	Colwell P indicating good soil P status
<15	Extremely low	20-24
15 – 35	Very very low	24-27
36 – 70	Very low	27-31
71 – 140	Low	31-36
141 – 280	Moderate	36-44
281 – 840	High	44-64
> 840	Very high	64+

Table 1: PBI Categories and published indicator Colwell P values required to support strong plant production. [Summit Fertilisers (summitfertz.com.au)](summitfertz.com.au)

To evaluate the Cations, Potash, K; Magnesium, Mg; Calcium, Ca; Sodium, Na; we are using various calculations, to assess the balance and interaction. The ratio of Ca to K, the ratio of Ca to Mg, the ratio of K to Ca and Mg. Some agronomists are advocating the Albrecht module, based on the Cation Exchange Capacity, CEC, and the calculated percentage of the Cations in relation to the sum of the CEC. Values below 3 relates to a light sandy soil, values around 5 to a medium loam, values above 10 to clay or silt.

The CEC is an important indicator as to the soil's nutrient holding capacity and reactivity, for example: to achieve a pH change from 5.0 to 6.0, at a CEC of 3, you may only need 1 t/ha of a lime with a NV of 100, whereas to achieve the same reaction with a CEC of 10, you may need 2.5 t/ha of the same lime. Both methods are used in your evaluation. Soil types do have specific features. A sand for example has a low nutrient holding capacity, which is reflected in the CEC, usually below 2.5. A clay/loam for example, having smaller soil particles, usually has a higher nutrient holding capacity and a CEC of greater than 7.5. A CEC above 12 is characteristic for a heavy clay.

The Cations not only provide a nutrient source for normal plant growth, but they have a very strong influence on the soil character, soil structure, water holding capacity, water logging and other associated influences.

An ideal soil should have a Ca:Mg ratio of 5 to 8, lower values indicate a dominating. influence of Magnesium. These soils are often referred to as Sunday soils, they get muddy and sticky, dry out quickly and set hard. In the CEC equation, the Calcium percentage should be between 64 and 75, the Magnesium percentage between 10 and 15. This has a strong influence on deciding if either lime or dolomite should be used, irrespective of the pH.

Contact: Joy Sherlock
Phone: 040 075 1614
Email: vaes@live.com.au
PO Box 211, Dongara, WA, 6525
www.vaes.com.au

A Ca:Mg ratio of 5 and below or a Calcium percentage of below 50 usually indicates soils which have poor flocculation ability, they have poor water holding capacity, dry out quickly, usually they have no structure. Lime is required to improve the basic soil fertility and productivity. Long term use of Urea or Ammonia compounds, especially if combined with high concentrations of Sulphur not only increase acidity but at the same time reduce the active soil Calcium concentration.

A Ca:Mg ratio should be between 6:1 – 9:1.
A result of 3.4 indicates 3.4:1.
Under 3-4 indicates more Magnesium in the system and potential soil structure problem, over 5 indicates more Calcium (add Magnesium).

Improving this Ca:Mg ratio improves Aluminium issues (when acidic soil and high Aluminium). Raising soil pH reduces influences of Aluminium, consider introduction of silicates to bind Aluminium – Aluminium Silicate – makes Aluminium inactive. Improving soil permeability by using gypsum will help to leach out the sodium.

If slightly acidic and slightly high Aluminium levels and Ca:Mg ratio is marginal, then dolomite may be recommended as (magnesium calcium carbonate) will introduce magnesium and the carbonate buffers the pH.

High Potash, ratio below 5 and percentage above 15 normally is associated with surface crusting; gypsum in most cases can reduce this.

A K:Ca ratio should be greater then 1:13 to be considered adequate in the Albrecht model, if you consider that soil microbiology will seek out and bring Potassium to the plant then there is consideration for less emphasis on Potassium and Calcium ratios. It would make sense to consider the K:Ca ratio when making soil amendments and recommendations because high calcium in ratios does reduce the availability of Potassium to the plant. Also don't underestimate the Magnesium to Calcium ratio as high Calcium will affect Magnesium taken into the plant.

To convert Exchangeable Potassium to Colwell Potassium ppm = K meq/100gm x 391
To convert Exchangeable Magnesium to Magnesium ppm = Mg meq/100gm x 122
To convert Exchangeable Calcium to Calcium ppm = Ca meq/100/gm x 200
To convert Exchangeable Sodium to Sodium ppm = Na meq/100gm x 230

Contact: Joy Sherlock
Phone: 040 075 1614
Email: vaes@live.com.au
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*Be aware that loading lots of cations into the soil (e.g., Calcium) shows elevated CEC – sand can have apparent CEC of 8 if lots of calcium in the soil.

These are a few examples of indicators which play an important role in adjusting or improving a soil character or structure problem and the selection and quantity of specific products.

The trace elements again are an indication only. Levels below a certain ppm concentration must be regarded as deficient (Copper and Zinc below 0.4 ppm). Levels above the deficient range can still be deficient due to strong reaction to pH (high pH negates Magnesium), concentrations of other elements (high Phosphate negates Zinc), cultural practices (no till reduces Zinc availability), fertilizer practices (high N, especially Urea reduces Copper), just to name a few reactions.

The next indication is the Carbon to Nitrogen ratio. Again, a calculated value derived from the Organic Matter and the total soil Nitrogen. The C: N is an indication as to your Nitrogen reserves in the soil. The ideal ratio should be around 15. Values below this usually indicate a Nitrogen surplus and no or little N should be applied at
seeding. It usually means, that plants have not been able to absorb N during the growing period or N rates have been too high in relation to the trace elements, dry conditions etc.

Levels above 25 indicate a problem in the Nitrogen metabolism within the plant structure, the forming of Amino acids etc, again in most cases associated with trace element reaction, also pH. On legumes and pastures a high C: N also indicates low activity of rhizobia.

Cultivation will increase the plant available N, no-till will reduce the available N. Higher rates of Nitrogen fertiliser are needed under no-till practices.

If we do have some variations over the respective sites, these will need special treatments. I do know that it is difficult to carry out separate treatments at seeding, so we must make a compromise at that time. However, we can adopt certain practices, such as pre-seeding applications of lime, dolomite, gypsum and if needed Potash applicable for the respective sites.

Contact: Joy Sherlock
Phone: 040 075 1614
Email: vaes@live.com.au
PO Box 211, Dongara, WA, 6525
www.vaes.com.au

Due to farming and fertiliser use, we can change the natural character. One of the greatest changes farming and fertiliser use can inflict on the soil can be the reduction. of Calcium, especially using Urea as well as Ammonia/Sulphate (Agras) based products. Several indicators, K:Ca, in a natural soil the Ca concentration should be at least 7 to 10 times the concentration of K. If Urea has been used for a long time, Sodium levels are usually high. Reducing Calcium levels and changing the Cation reaction, especially the Ca: Mg can induce poor water management of the soil and gradually these soils lose structure and productivity. Low to marginal concentrations of Magnesium, Mg, are usually associated with long term use of Phosphate. These indications however must be seen in relation to the soil type.

Interpretation of Results

Nitrogen

Total Nitrogen

Total Nitrogen is preferably measured by the Kjeldahl method and is expressed as %. However, many labs will use a different test, CSBP does use Leco method and the results are expressed as %. Leco results vary to Kjeldahl, and we need to understand that different methods will give slightly different results. Leco is becoming a more widely used method of analysis due to supposed reduction in variation.

To convert from N% to ppm = Total Nitrogen % x 10,000

You could imagine that between 500 – 2000 may be useful. What is very important is know how much Organic Carbon to Nitrogen there is in the soil. The C/N ratio gives guidance to the effects on nitrogen draw down by microbial activity that may compete with plant nitrogen requirements under certain weather and soil conditions. Raw undigested organic carbon will have a marked effect on nitrogen availability to plants as soil microbial activity consumes nitrogen to break down organic carbon in warm and moist soil environments. The soil biology will form part of the organic nitrogen and organic matter in the soil at the completion of digesting raw organic carbon. There is a cycle of consumption of nitrogen and release of protein (Nitrogen)

Total Nitrogen (Kjeldahl) is total N in soil (which includes all sources of nitrogen including proteins from ammino acids, ammonia, nitrate, nitrous oxide).

Less than 100 indicates minimum/marginal level.
400 – 500 indicates moderate levels and 750 – 1000 indicates high levels.

Contact: Joy Sherlock
Phone: 040 075 1614
Email: vaes@live.com.au
PO Box 211, Dongara, WA, 6525
www.vaes.com.au

Carbon / Nitrogen ratio = Organic Carbon % divided by Total Nitrogen%

Nitrate Nitrogen and Ammonium Nitrogen
Should be 2/1 – this indicates good mineralisation happening i.e., Nitrate Nitrogen of 20 and Ammonium Nitrogen of 10 means good nitrogen mineralisation is occurring.

However, be aware of previous comments regarding stability of Ammonium Nitrogen and variability due to weather conditions and soil.

High carbon to nitrogen ratio (C: N) say over 18 – 20 + apply Sulphate of Ammonia

C: N 18 usually applied 100kg/ha
C: N 20 usually applied at 150 kg/ha
C: N 25 usually applied at 200kg/ha

C: N Ratio (13-17) Nitrogen will be ok provided organic matter is over 4% (not likely in wheatbelt).

C: N Ratio (under 12) can indicate a soil structure problem or poor aerobic/aeration considerations. Use Calcium Ammonium Nitrate (CAN) in preference to Sulphate of Ammonia. Cultivation may improve aeration and improve N mineralization.

*If Calcium is over 65% then need to use Gypsum if cultivation is not possible.

Apply CAN (26%N) or Sulphate of Ammonia at 75 – 100kg/ha.

** Potassium Nitrate only good for foliar or maybe fertigation due to cost and effect.

*** Pastures showing long grass around the cowpats indicates low Magnesium and or Manganese and the need to check soils. This indicator is a response to grasses taking up Ammonium nitrogen and not the form of Nitrate nitrogen. Nitrate is used in photosynthesis and produces sugars that are attractive to livestock. Ammonia is bitter tasting and hence this is why the grass is long around the cowpats. Having adequate plant available Mg or MN helps with the uptake and photosynthesis.

Sulphate (SO4) and Ammonia (NH4)

Reporting on Sulphur and Ammonia can be dubious due to variation caused by rainfall, soil moisture, temperatures/heat, microbiology etc. It is only useful if soil

Contact: Joy Sherlock
Phone: 040 075 1614
Email: vaes@live.com.au
PO Box 211, Dongara, WA, 6525
www.vaes.com.au

results are immediate after taking the samples and be aware variations can occur during transporting samples to the lab.

Generally looking for Sulphur levels between 10-20. Use as a guide as Sulphur will be consumed by soil microbiology and released at later time depends on weather, soil moisture etc.

Phosphate

pH below 5.5 we use Single Superphosphate.
PH 6+ we use triple Superphosphate (TSP) MAP or DAP, it depends on C:N ratio as to which products are used.

If Phosphate is below 40ppm we need to consider 20 units of P.
If Phosphate is 60PPM we only go as high as 10 units of P.
If Phosphate is over 60 ppm, we only need 5 units of P.

Single supper is 9.5% P therefore 10 units of P would require 100kg/ha application.
MAP and TSP are at 22% P therefore 10 units of P would require 50kg/ha application.
DAP is 20% P therefore 10 units of P would require 50kg/ha application.

**Available Phosphate as shown on the report is generally 5-10% of total P in the soil.
**If available P is less then 5% of the total then this could be due to fixing problems caused by Aluminium, Iron or Calcium (in many cases Calcium is the culprit, maybe from overuse of liming in the soil).

Potassium

Sulphate of Potash is used if Nitrogen levels are high.
Muriate of Potash is used if Sodium (Na) levels are low.
CEC is relative to Sodium content and ability to cope with application rates.

High CEC = Higher rates = up to 150kg/ha
Low CEC = Lower rates say 50kg/ha.

Sulphate of Potash is 42% K and 18% S.
Muriate of Potash is 50% K and no Sulphur.

Copper

If level is below 0.4 = apply 3kg of Copper Sulphate per hectare.

Contact: Joy Sherlock
Phone: 040 075 1614
Email: vaes@live.com.au
PO Box 211, Dongara, WA, 6525
www.vaes.com.au

If levels are above 0.4 = don't bother as levels are adequate.

Generally looking for levels of 0.4 – 9 ppm.

Zinc

If level is below 0.4 = apply 5kg of Zinc Sulphate per hectare.

**High phosphate levels in soil can result in lock up of zinc and if this is happening, we need to look at foliar applications of zinc (as this is the only practical solution).

Generally looking for levels of 0.4 – 1 ppm.

Manganese

Manganese is closely related to pH. The higher the pH the less Manganese is available and the more needs to be applied.

pH 5 or less and analysis level shown at 3.5 apply 10 kg/ha.
pH 5.5 and analysis shown as 3.5 apply 15 kg/ha.
pH 7 and higher and analysis shown at 3.5 apply 20 kg/ha.

Generally looking for levels of 3.5 – 9 ppm, 20 – 50 would be excessive.

Magnesium

High Magnesium levels cause issues with soil structure and create "Sunday" soils – very hard soils that quickly become slippery and boggy when wet. High magnesium soils are found in the wheatbelt and other areas. High magnesium in soils can be a bigger problem then high calcium as it is very hard to correct.

Iron

Iron doesn't become a problem until levels are 250 – 300 ppm.

Generally looking for levels of 20 – 40 ppm. > 250 ppm will impact uptake of parameters such as P, Ca, N and K.

Boron

Very low = 0 - 5 ppm
Low = 0.2 – 0.5 ppm
Medium = 0.5 – 1.0 ppm

Contact: Joy Sherlock
Phone: 040 075 1614
Email: vaes@live.com.au
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High = 1-2 ppm
Excessive = > 2 ppm

Borax has 10% elemental Boron…10kg/ha Borax will yield 1 kg/ha Bo - 1 ppm.

Molybdenum
Around 0.5 ppm - 1ppm is ok, excess not normally found, tissue test recommended for Molybdenum.

Chloride

We see high levels of chloride with poor water use, poor quality water, Muriate of Potash is potassium chloride, combination of sodium and chloride is NaCl – common salt.
Very low = 0 - 5 ppm
Low = 5 – 10 ppm
Medium = 10 – 20 ppm
High = 20 - 50 ppm
Excessive = > 50 ppm

Lime/Dolomite or Kieserite?

Lime = Calcium Carbonate (CaCo3)
Dolomite = Magnesium Carbonate (MgCaCO3)
Kieserite = Magnesium Sulphate (MgSO4)

Dolomite

If Ca: Mg ratio is over 9, should use dolomite.

CEC below 5 then apply 500kg/ha.
CEC 5 – 10 then apply 750kg/ha.
CEC above 10 don't bother as Magnesium to high, Consider lime, check calcium levels.

Kieserite

If Ca: Mg ratio is over 10 and Calcium is over 80% then use Kieserite.
40kg/ha up to 80 kg/ha depending on $$$ available.

Contact: Joy Sherlock
Phone: 040 075 1614
Email: vaes@live.com.au
PO Box 211, Dongara, WA, 6525
www.vaes.com.au

Lime

Never go above 1.5 t/ha of agricultural lime per ha in one year unless cultivated into the soil. Only use a maximum of 2 t/ha of agricultural lime if cultivated in and only provided that the CEC is well above 10!

If CEC is below 3, don't use more then 750kg/ha.
If CEC is between 3 – 8, apply 1 t/ha.
If CEC is over 8, use up to 1.5 t/ha (but look at repeat annual applications).

*Don't apply rates above 1.5 t/ha annually unless cultivating to incorporate into the soil.
*Don't forget applications of lime are slow acting, it may take a year or two to see full results.

Organic Matter/Organic Carbon

Our program uses Organic Matter expressed as a %.

CSBP provide Organic Carbon and this needs to be changed to Organic matter.
The 10CSBP program in V file does the conversion for us.

Otherwise need to calculate ourselves.
Organic matter /1.78 = Organic Carbon or Organic Carbon x 1.78 = Organic Matter.

Organic Carbon levels of 4% are ideal for microbes however in the wheatbelt you will see levels of 1.5 – 2.

When looking at Total Organic Matter levels you should see between 3-4%

Molybdenum

Sampling should be done prior to flowering only.

e.g.
0.5 ppm for grapes is adequate. Below 0.4 ppm requires addition.

Leaf sample, values below <0.9 ppm at peak flowering are showing deficiency.

Contact: Joy Sherlock
Phone: 040 075 1614
Email: vaes@live.com.au
PO Box 211, Dongara, WA, 6525
www.vaes.com.au

0.09 – 0.45 ppm are ok and respond to foliar application is uncertain. >0.45 ppm response to foliar application is unlikely.

High Calcium Sands.

Can help to balance effect of high calcium by the application of elemental Sulphur (comes as powder prill).

*The reason we use elemental Sulphur on soils that have high Calcium is so that we can create Calcium Sulphate ($CaSO_4$) which is Gypsum.

Gypsum

Gypsum is Calcium Sulphate. It is essentially a neutral salt and DOES NOT reduce soil pH. The proper use of Gypsum is to correct a sodic (high sodium soil) over time. The Calcium in the Gypsum replaces the sodium from the “soil arm”, and the sodium combines with the sulphate (sodium-sulphate) which then must be washed (leached) away.

Soil tests which show a soil ESP value of 15% or more require a gypsum treatment program.

If 90% ExCa use around 75 kg/ha of Sulphur.
85% ExCa use 50 – 60 kg/ha of Sulphur.
70% or below, don’t bother with Sulphur

Contact: Joy Sherlock
Phone: 040 075 1614
Email: vaes@live.com.au
PO Box 211, Dongara, WA, 6525
www.vaes.com.au

Guide to Nutrient Removal by Crop.

			Nutrient Removal By Crop						
Nutrient Removed by			Kilograms					Grams	
1 tonne of Grain	N	P	K	S	Ca	Mg	Cu	Zn	Mn
Cereals	12 - 25	1.8 - 4.0	3.0 - 6.3	1.1 - 2.5	0.2 - 0.7	0.9 - 1.7	1 - 6	15-35	16 -74
Barley	20	2.7 - 2.9	4.4 - 5	1.1 - 1.5	0.3	1.08 - 1.1	3	14 - 15	11
Wheat	23	3	4	1.4 - 1.5	0.33 - 0.4	0.93 - 1.2	5	20 - 29	40
Oats	16 - 17	3	4 - 5	1.4 - 1.6	0.5	1 - 1.1	3	17	40
	N	P	K	S	Ca	Mg	Cu	Zn	Mn
Grain Legumes									
Chickpeas (Kabuli)	34 - 36	3.4 - 3.8	8.9 - 9	1.8 - 2	1 - 1.1	1.2	7 - 8	33 - 38	22 - 34
Faba Beans	39 - 41	3.8 - 4	9.8 - 10	1.4 - 1.5	1.1 - 1.3	1.0 - 1.2	10	28	30
Lentils	42	3.9	8	1.8	0.7	0.9	7	28	14
Lupins SEED	40 - 60	2.0 - 4.0	7.0 - 9.3	1.5 - 3.0	1.5 - 3.8	1.0 - 2.2	3 - 7	24 - 45	6 - 63
Lupins (White)	51 - 60	3.6 - 3.8	8.8 - 10	2.4 - 3.1	1.7 - 2	1.4 - 1.7	5	30	60
Field Peas	37 - 38	3.4 - 4	8.2 - 9	1.8 - 2	0.7 - 0.9	1.2 - 1.3	5	35	14
Common Vetch	49	3.8	NA	NA	0.8	NA	NA	NA	NA
	N	P	K	S	Ca	Mg	Cu	Zn	Mn
Oilseeds									
Canola Seed	20-40	3.5 - 6.0	5.0 - 6.9	2.9 - 4.0	3.8 - 4.4	2.5 - 3.0	2-7	27 - 38	18 - 44
Canola	41	6.5 - 7	9 - 9.2	9.8 - 10	4 - 4.1	3.8 - 4.0	4	40	40
	N	P	K	S	Ca	Mg	Cu	Zn	Mn
Hay/Pasture									
Oaten Hay tDM	9-15	0.9-1.5	9-21	0.8 - 1.5	1.0 - 3.3	0.8 - 1.4	9-24	55-110	130 - 540
Cereal Hay tDM*	20	2	18 - 25	1.4 - 2	0.5 - 0.6	1.1 - NA	7	20 - 25	40 - 50
Lucerne Hay tDM	33	3.3	28	2.4	11	2.1	6	21	56
Lecerne Seed	60	6.8	11	2.5	1.3	2.2	11	43	17
Medic Hay tDM	30	3	25	2	9	NA	8	20	15
Medic Seed	64	8.4	12	5	2	NA	7	23	13
Oaten Hay tDM	20	2	18	1.4	0.6	NA			
Hay (Clover/ryegrass) tDM	30	3	25	2	9	2			
Silage (Clover/ryegrass) t	30	4.3	27	NA	7	1.7			
Cereal Straw	1.4 - 4.7	0.2 - 0.3	0.5 - 7.0	0.3 - 0.7	0.9 - 2.5	0.3 - 1.0	1 - 4	2 - 7	1 - 19
	N	P	K	S	Ca	Mg	Cu	Zn	Mn
Stubble									
Wheat	17	1.8	42	2.7					
Canola	18	2.4	70	4.8					
Lupins	17	0.6	26	2.7					
	N	P	K	S	Ca	Mg	Cu	Zn	Mn
Animals									
100kg Beef	27	7.2	0.2						
Sheep Live	34	7	2.3	4	14.4	0.4			
One Fat lamb (40kg)	2.3	0.2	0.1	0.2	0.4				
Greasy Wool	170	0.26	15.8	28.5	1.2	0.3			
One wool fleece (4kg)	0.7	Trace	0.1	Trace	Trace				
1000L Milk	5.7 - 6	0.95 - 1	1.4	0.6	1.2	0.12			
100 kg Milk Solids	9	1.4	2	0.8	1.7	1.8			
One DSE - Sandy Soil	6	1.5	0.5	0.75					
One DSE - Heavier Soil	4	1	0.3	0.5					

 # All figures are general in nature and will vary within individual systems, use as a guide only.
Burning or removing stubble will increase the nutrient removal rate of Nitrogen, Sulphur and Carbon, other nutrients such as Potassium, Phosphorous and trace elements will remain but are more susceptible to erosion from wind or water.
**tDM = tonne of dry matter NA=Not available*
** range is due to variation in available data i.e from CSBP and Summit vs other graphs

https://www.summitfertz.com.au/field-research-agronomy/nutrient-removal
Grain sampling and nutrient removal budgets (csbp-fertilisers.com.au)

Contact: Joy Sherlock
Phone: 040 075 1614
Email: vaes@live.com.au
PO Box 211, Dongara, WA, 6525
www.vaes.com.au