IMPLICATIONS OF SOIL BALANCE ON PASTURE PRODUCTION PASTURE PALATABILITY
ANIMAL HEALTH and PERFORMANCE

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Power of Soil, plant, feed and blood analysis:

One must never under estimate the value found in information received from these four types of analyses, they hold information that gives you the power to control the nutritional status and productivity of your stock

I find that it is the interpretation of data that is often the limiting factor. So you also need understanding – not only understanding of the interpretation of data received but also understanding its importance and application. Too often I see clients taking and using only sections of the data received based on not sure what?

The identification of all limiting factors in your operation is essential, whether it's in your soil, pasture, supplementary feed or mineral additives, once a deficiency or excess or otherwise has been identified and corrective treatment taken then you will start to benefit from increased productivity.

Too often we use shot gun mixes that may or may not correct our deficiencies. There are many mixes available that make excellent supplements but you still need to ensure they cover all the bases. Too often I see farmers listening to too many sales agents and changing to products that don't supply what is required

Productivity: All aspects of animal productivity and health are determined by what goes into the stomach. And most can be prevented with understanding and planning.

These are:

Growth rates
Mineral deficiencies – Copper – Cobalt – Zinc – Magnesium – Calcium – Selenium – Manganese etc
Conception
Birthing problems - difficult birth or still births.
Metabolic Problems – milk fever – grass tetany (magnesium deficiency) – acidosis.
Lameness
New Born health – at birth and in the first few weeks after birth. Weakness in young can be related to the mother's diet before giving birth, eg high to excess protein
Bone development – in young stock. E.g. effects of copper deficiency during gestation.
and many more

All are preventable but first we need a total understanding of requirements, soil, pastures, supplements and diet.

Eg. I have seen a 300% increase in lamb growth rates when we helped a farmer understand his lamb requirements and the side effects of excess protein in the pasture in an irrigation situation

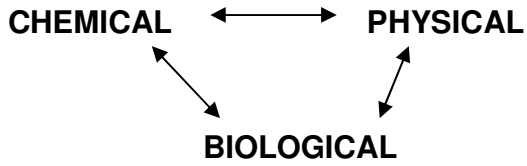
Identify limitations. Are they?
[a] Soil imbalances

[b] Pasture species or pasture production
[c] Pasture and supplement quality
[d] Mineral deficiencies
[e] Misunderstanding of what and when to feed what

Let's first look at the soil

The three phases of the soil are interdependent.

That is to say that you cannot change one phase of the soil without affecting the other phases of soils.



Each influences the other.
If pore space is increased by altering the chemical balance ➔ increased microbial activity ➔ improved soil structure ➔ more natural N ➔ more available P.

This refers to the minerals, including nutrients that make up the soil
This aspect of the soil is measured using soil analysis techniques.

Changes in the chemistry of soils affect

soil biology, organism populations and diversity.
soil structure, soils with adequate calcium are often well structured and friable whereas soils high in sodium have poor structure and are hard setting. Soils that are wet and sticky in the winter and hard setting in the summer are high Magnesium low calcium soils

Physical

Refers to the structure of a soil, hardness, friable nature, and porosity.

Changing the physical aspect of the soil
Affects nutrient availability
Changes the way water behaves in a soil. High Mg/K soils are impervious with limited water movement, high Ca soils have limited water holding capacity, ideally balanced soils generally hold optimum moisture
Affects the biology of the soil, tight compacted soils may not accommodate large soil organisms like worms and insects.

Biology

The biology of soils is one of the hardest aspects of the soil to measure and interpret. The simplest and most manageable way is by observation, the rate at which stubbles degrade, wormhole counts etc. In recent time the biology of soils and its importance has attracted much attention and research activity.

Changing the biological aspect of the soil:

Affects nutrient weathering and nutrient availability. Soil organisms are involved in the decomposition of soil minerals and organic residues into soil and plant nutrients.

Affects the structure of the soil by the decomposition of organic residues. Organic cements are produced which help to glue soil particle together. Plant roots increase soil aggregate stability.

REMEMBER:

Plant/Animal deficiencies not only occur due to lack of a mineral but are…

Also are created by excesses.

A nutrient excess in the soil will always result in the deficiency of another element in the plant, so when evaluating any analysis results not only look for deficiencies but also look for excesses. Eg, High soil Mo = low animal Cu, high soil Potassium = low plant Mg, Mn and B and low animal Mg and Na and there are many more examples

Nutrient interactions are complex and require consideration when planning fertiliser budgets for pasture and crops. The effect the interactions between soil elements can normally be seen in a tissue analysis. This it explains the need for a tissue analysis to help correct any nutrient disorder due to a deficiency or some other nutrient interaction.

What Is A Well-Balanced Soil?

- **Contains good levels of sulphur, phosphorus, organic matter, calcium, magnesium, potassium, sodium and trace elements.**
- **Has a good soil structure**
- **Good water retention**
- **Good water movement both up and down**
- **Allows for good root development.**

How Soil Balance Affects Pasture Palatability & Animal Health

Soil Balance and It's Importance

Pasture species are very versatile and tolerant to various soil conditions and will grow in a wide variation of soils that contain different nutrient balances. For optimum stock performance we need to produce both a palatable and nutritious pasture for our stock as well as achieving a reasonable pasture volume. As the levels of all nutrients are critical for healthy pasture and stock performances we need to look for any limiting factor that is adversely affecting either pasture or animal productivity. As the ratios of soil calcium to magnesium to potassium to sodium change so does pasture palatability. As we change palatability we change productivity.

MAGNESIUM: Soils with excess magnesium are wet and sticky winter & hard setting summer soils. Calcium is low and they lack air space, microbial activity and nitrogen production. They have very poor water movement both up and down. This can mean a lack of winter / early spring growth due to wetness and poorer late spring / early summer growth due to poorer water movement up through the soil. Excess soil magnesium will suppress plant potassium and reduce pasture production.

High magnesium soils are characterised by their ability to stick to boots, machinery and everything that passes through them.

The lack of air space means plants growing in these soils generally have very shallow root systems. A stressed root system will cause the plant to accumulate higher levels of Non Protein Nitrogen. So we often see a higher incidence of lameness, mastitis and grass tetany on these soils. Pastures are often unpalatable which reduces dry matter intake and animal performance.
An interesting point with high magnesium soils is that the pH doesn't indicate a lack of calcium.
If we add calcium in the form of lime, we increase air space by altering the chemical balance ➔ increased microbial activity ➔ more natural N ➔ more availability of P.
Increasing the Ca:Mg ratio (Ideal 5.5:1) ➔ less compaction ➔ greater soil water movement, both down and up and a reduction in soil sodium. This means a greater utilisation of water.

CALCIUM controls the plant absorption of all other minerals. Plants growing on low calcium soils will absorb higher levels of iron and aluminum, which can be toxic to growth. Increasing soil calcium to the ideal will negate the adverse effects of excess soil aluminum and iron.
Effects on plants are an increase in pasture growth due greater root development and an increase in pasture palatability. This enables an increase in stock performance and a greater long term establishment of good pasture.
High calcium soils have poor water holding capacity; poor late spring / early summer growth; increased trace element deficiencies; and decreased P recovery. This means a lower percentage of applied P is available to the plant.

POTASSIUM One of the confusing issues with potassium is that pasture requirements are totally different to animal requirements. For example, pastures species require 2.5% to 3.5% leaf potassium for optimal growth. Animals only require approximately 1.2% potassium in their diet. Pasture samples will often show a level of potassium that will be limiting pasture production but will in excess for stock. The reason why many farmers are reluctant to apply soil potassium due to high pasture potassium levels, even when there is a soil deficiency. You must always address a soil deficiency before considering pasture levels, remember you are growing a crop and it is in the form of pasture, it is still being harvested but being harvested by your stock, for optimum pasture production you must think of it as growing a crop. On the other hand excess soil potassium can suppress plant magnesium, boron and manganese resulting in unpalatable pastures. This demonstrates the importance of taking both soil and pasture for analysis. When soil potassium is high I would expect to see an increase in metabolic problems. High soil potassium can be a natural occurrence eg NSW soils where we often see soil K higher than soil Mg, or areas where there is high stock concentrations or where high rates of animal manures have been applied. Stock grazing areas where there is high soil potassium will require a higher intake of sodium so ensure salt is available at all times

SULPHUR. This is critical for nitrogen utilisation by plants and animals. It is essential for healthy stock, meat and wool production. Low soil sulphur = poor pasture production with reduced animal performance, excess soil sulphur may suppress animal copper and selenium. Super phosphate contains 11% sulphur, the value of which is often overlooked when applying this product.

BORON Essential for plant reproduction, pasture energy, nitrate reduction and calcium absorption. When grazing fresh pasture, maintaining a good boron status in your pastures will increase pasture palatability and reduce metabolic problems. Essential for all plants, legumes and woody species have a high boron requirement

Trace elements Copper, Manganese, Zinc and Cobalt

All are essential for both plant and animal health. Copper deficiency is often a problem where soil molybdenum is high, never apply fertiliser Mo unless you know the soils Mo status. Zinc deficiency is common when stock is grazing fresh high protein pastures. Here we often see skin lesions which will clear as the pasture matures and protein levels decrease

What Consideration is pH?

PH - Soil Acidity: Ideal 6.0 to 6.5 (in water)

PH is one of the most misunderstood factors on our soil reports.

SOIL PH IS ONLY A MEASUREMENT OF THE HYDROGEN, NOT AN INDICATION OF SOIL NUTRITION OR MINERAL BALANCE.

PH gives no suggestion as to which nutrients are grossly deficient or to what degree the nutrients are unbalanced

The balance or levels of the four major cations calcium, magnesium, potassium and sodium are what influences pH. Soil acidity (or the alternative soil reaction) refers to the concentration of hydrogen ions (H^+) in the soil solution, or more correctly the relative concentrations of H^+ and hydroxyl (OH^-) ions. The degree of acidity (or alkalinity) of a soil, or of any other systems, is expressed by means of the pH scale.

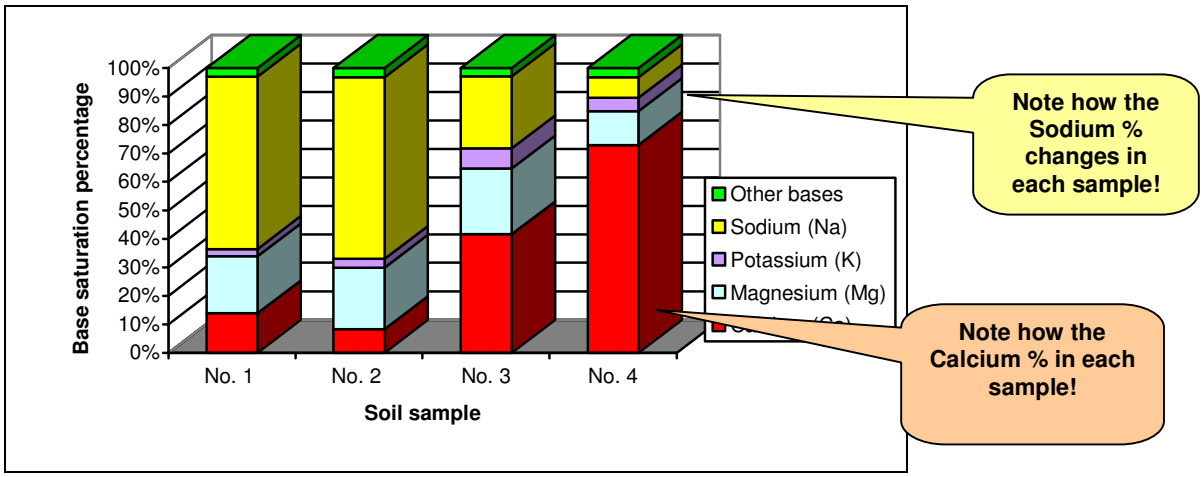
PH can be looked upon as displacement. Hydrogen is displaced as cations are added to the soil complex. This causes the pH to increase. As plants use the cations (Calcium, Magnesium, Potassium and sodium), they are replaced by hydrogen and the pH goes down.
The pH of a soil is constructed with all the major cations (Positively charged elements) Calcium, Magnesium, Potassium and Sodium. Ph levels in NSW soils are often formed with high K, SA soils with Mg and Ca, Northern Victorian soils with high Mg. It is important to know just how the pH of your soil is constructed

Base Saturation Percentage and pH Values

The following chart shows how the wrong information can be gained from using pH to establish the fertility or balance of a soil.

The 1st sample taken from the centre of a salt pan, 2nd edge, 3rd 50mtres from edge and 4th 100metres out,

8.3 pH **8.1 pH** **8.4 pH** **8.1 pH**



The above chart shows similar pH values but with different makeup

No 1 Middle salt scald – 2 Edge of scald – 3 -50mtres into crop – 4 -100mtres into crop

PASTURE ANALYSIS:

An analysis tells you directly the quality and nutrient levels that your animals are consuming. A pasture analysis does not give you a good indication of soil levels as the soils mineral status will control what a plant takes up. Eg High Ca soils = low plant trace elements, phosphorus and magnesium, high soil potassium = low plant magnesium, boron and manganese.

A pasture analysis will help to complete the picture of what is happening in your soil and what effect the soil is having on plant uptake

Pasture Species: On the same soil different pasture species will extract various levels of the same element, so it is advantageous to have a variety of species in your pastures. Eg Grasses are generally low in magnesium, clovers are higher in magnesium. NZ trials with growth rates in lambs showed a difference from 23kgs to 37kgs with the same dry matter intake

So the challenge for you is to recognise the changes in pasture nutrition and supplement accordingly to meet your animals requirements for optimum production.

Alpacas are out of their natural environment and comfort zone

We must recognise and understand their natural environment and feed source. They graze on slow growing species that will be naturally low in protein and contain high levels of nutrients. Alternatively faster growing immature species are high protein and generally lower in essential nutrients.

All high country animal species require lower protein diets for optimum production – Deer, Merinos, Goats and Alpacas. For optimum production we need to understand their basic requirements and how can we replicate their natural environment or negate the side effects created in a different environment?

Salivation time: This is the most critical aspect of helping alpacas adapt to your environment this is the time taken chewing and producing saliva. The amount of saliva produced is an essential and critical

part for the efficiency of every of every animal's digestive system. In their natural habitat Alpacas produce maximum saliva as they have a high fibre low protein intake – This means a lot of chewing and optimum saliva production = optimum digestive pH, see below how as the eating rate decreases saliva production increases. As we increase dietary protein, digestion time and chewing (rumination) time is reduced stomach pH stays lower and we see various levels of acidosis subclinical to clinical and naturally lower productivity

Effect of Ration on Eating Rate & on Saliva Production

Feed	Eating Rate of lbs of feed/min	Salivary Production Teaspoons/Pound of Feed
Pelleted	0.79	1.0
Fresh Grass	0.62	1.5
Silage	0.55	2.0
Dried Grass	0.18	5.0
Hay	0.15	6.0

Source: Bailey, C.R. 1958. The role of secretion of mixed saliva in the cow.

Alpacas have a high fibre requirement – see above the difference in saliva production between dry feed and fresh green pasture

Ask yourself the question: Are your animals producing the optimum amount of saliva for optimum production?

FEED ANALYSIS

VALUE and TIMING of SUPPLEMENTS to improve pRODUCTIVITY

The first point to make is that many supplements and animal treatments are wasted due to:

- Poor timing of supplementation or animal treatment;
- Misunderstanding of animal requirements: All have different daily needs.
- Lack of knowledge as to what the nutritional status is of various supplements.

What are the basics of a feed?

- Protein
- Energy (measured as ME / kg DM)
- Minerals
- Vitamins
- Water

How do these basics match the requirements of your stock?

A supplement must be a feed that complements the main diet or paddock feed. The idea of a supplement is to provide nutrients that are deficient or to provide extra feed to improve stock performance.

It must balance the main diet to the ideal. Eg if stock are grazing high protein pasture then a high energy high saliva producing feed is the ideal supplement. In cases of a severe feed shortage the supplement maybe the complete diet.

If you are providing an additional feed that has a similar composition to the feed already available in the paddock. Then you are not providing a supplement. Any supplement you provide must complete the diet necessary to maintain or improve productivity.

Protein/Carbohydrate Balance

This is the most important starting point when evaluating a diet for any class of livestock, get this right and the mineral vitamin content becomes less critical.
Excess protein increases requirements for both minerals and vitamins and also reduces salivation time which is critical for all species. Once salivation time is reduced intestinal pH is reduced and in severe case we see an acidotic condition

Alpaca Protein Requirements

Maintenance	8% to 10% Crude Protein
Rapid Growth from weaning	16% Crude protein
Pregnancy and Lactation	12% to 14.5% Crude Protein

Impact of Excess Pasture Nitrogen (Crude Protein) On Animal Performance

If the diet is protein rich to the point where it is energy deficient there is a damaging effect on the liver.

Side Effects of Excess Protein & low energy

- Unnecessary expense
- Increased energy requirements
- Scouring
- Increases requirements for trace elements
- Weight loss
- Vitamin A reduction
- Pasture burns
- Magnesium suppression
- Lameness
- Poor conceptions
- Full term young born dead.
- Weakness at birth
- Early deaths at 7 to 10 days of age
- Mis-mothering

Pasture Analysis showing the different requirements between pasture and stock. See how pasture requirements differ from animal requirements

Pasture analysis report -

Date sampled: 6-Nov-01 Stock Cattle Sample name: MAGPIE

Desired Range		Results - Relative to Plant Requirements	Your Test Results		Results - Relative to Animal Requirements	Target level
		Deficient / Low / Optimum / High			Low / Adequate / High / Excess	
4.50 - 5.50	N		Nitrogen %	3.82	N	3.0 - 4.0
0.34 - 0.42	P		Phosphorus %	0.41	P	0.39
2.50 - 3.00	K		Potassium %	2.28	K	1.20
0.35 - 0.50	Ca		Calcium %	1.33	Ca	0.70
0.16 - 0.22	Mg		Magnesium %	0.21	Mg	0.20
n/a	Na		Sodium %	0.73	Na	0.20
0.27 - 0.32	S		Sulphur %	0.31	S	0.20
10 - 20	B		Boron ppm	11	B	n/a
50 - 65	Fe		Iron ppm	106	Fe	50
25 - 30	Mn		Manganese ppm	9	Mn	40
6 - 7	Cu		Copper ppm	7	Cu	10
14 - 20	Zn		Zinc ppm	35	Zn	50
0.15 - 0.30	Mo		Molybdenum "	1.2	Mo	0.15
n/a	Se		Selenium ppm		Se	0.10
n/a	Co		Cobalt ppm	0.09	Co	0.10
n/a	I		Iodine ppm		I	0.50
0.3 - 2.4	Cl		Chloride %		Cl	0.25

Moisture	85.8 %	Milk Fever Index (K+Na)-(S+Cl)	good		170 - 270
Crude Protein	23.9 %	Staggers Index K/(Ca+Mg)	ok	0.7	2.2 max.
Digestibility	74.8 %	Calcium/Phosphorus ratio	too high	3.2	1.0 - 1.5
Metab. Energy	10.9 MJ / kg DM	Bloat Index	ok	3.1	< 20

Blood analysis:

Use to identify mineral deficiencies in livestock. Test for Vitamin B12 (Cobalt), Vitamin D, Selenium, Copper and Zinc. With this information you can complete the nutritional picture, it confirms whether or not you are supplying the optimum for optimum health and productivity.

Vitamin A We often hear how much vitamin A there is in green plants and the belief that pasture contains high levels of this essential vitamin, but in fact green plants contain only carotene which is the precursor of vitamin A. Carotene is then converted to vitamin A in the body but if protein (Nitrogen) intake is high to excess then this conversion is limited and the animal becomes vitamin A deficient.

Alpacas in their natural environment consume low protein plants, vitamin A deficiency wouldn't be an issue, however when consuming high protein species vitamin A deficiency would become an issue, this

problem is not only limited to alpacas but to all livestock, in my consulting I also ensure there are good supplies of A

You all have total control of your animal's health and productivity, if you have an issue then any or all of the above will help you solve the problem. To do this you may need to step outside the square and look at the wider picture.
Alpacas come from a different environment, you don't need to replicate this environment but you can effectively counter the side effects they will experience of being in a different place.

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