Fact or Fiction?

Optimizing the fertiliser \$\$? Questions for the fertiliser salesman?

D C Edmeades. ONZM. MSc (Hons), PhD, Dip Man.

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Part One

Some Principles

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Vince The sale of the second of second second second

Get the **soil fertility** right and the **soil biology** looks after itself.

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Winchmore long term trial



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Soils Do Not Make Nutrients

- Soils store nutrients
 - Either 'natural' nutrients or applied nutrients
- What you remove you must replace
 - Otherwise you are going backward

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Plants Need

nutrients

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Von Liebigs Law of the Minimum (circa 1850)

"A plant will only grow as fast as allowed by the most limiting nutrient"

e.g. Applying more super (P + S) on a K deficient soil is a waste of money

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CLOVER is KING



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4-5 cents per kg dry-matter

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BUT

Clover has a higher requirement for all nutrients!

If clover growth poor then there is a soil fertility limitation

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MARS SPORT

Recent Soil Survey (219 soil samples)

None had ideal balance!!! (i.e. optimal levels of all nutrients)

Remember Liebigs Law and the weak link in the chain?

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Diagnosing Soil Nutrient Problems

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CARLES RACE

Beware!!! <u>Vagaries of soil testing</u> Easy to get inflated/wrong results

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Best Practice

- Visual assessment
- Soil Test results
- Clover-only tests

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Critical Clover Concentrations

P = < 0.3% K = < 2.0% S = < 0.25% Mg = < 0.15% Ca < < 0.20%Mo < 0.10 ppm

Only way to test for Cu, Zn, & Mn???

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Alternative Soil Testing Methods

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BCSR Theory/Albrecht

 1930s: 2 emerging theories of plant nutrition:

a new gradient and was served a

- <u>Quantity Theory</u> minimum amount of each nutrients required (applies to all 16 nutrients)
- <u>Ratio Theory</u> need to have correct ratio of nutrients (applies only to the cations Ca, Mg, K and Na)





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From Kopitte and Menzies 2007



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The Jury is Out

- Albrecht's BCSR is flawed
- It only applies to 3 of the essential nutrients (Ca, Mg, K)
- Results in incorrect fertiliser advice

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Part 2: Fertiliser Products

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Liquid or Solid Fertilisers?

Treatment	Relative Yield
Control	100
Liquid fertiliser	106
Solid fertiliser (equal nutrie	nt) 106
Solid fertiliser (equal cost)	118

Mean 4 trials on nutrient deficient soils

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Form of Product

<u>Solid? – Suspension? – Liquid?</u> The plant does not care!

Forget about

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Qualification: except on calcareous soils

- foliar feeding
- soil P fixation

Same applies to organic or chemical fertilisers

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Best Advice

- Calculate the amounts of each nutrient required
- Choose the least-cost product(s) to do the job.

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• Whether chemical or organic, or solid or liquid.



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Interpreting Field Trial Results

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Background Noise in Field Trials

- UK scientist measured: control v water (225 l/ha) on crop production.
- This amount of water will have no agronomic effect on crop growth.

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 There were 66 trial-years of data covering a range of crops.



The range of 'responses' (-30% to +30%) reflects the background variation in crop yields.



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This is what the background noise looks like

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For products which increase production the distribution of responses moves to the right



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Example 1: Maxicrop

Background

• Liquid fertiliser – seaweed extract

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- Typically applied 10 l/ha
- Claims many



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Claimed mode of action

- 1. Nutrient content 83 'nutrients'
 - \$800/drum contained < \$10 nutrients
- 2. Organic matter stimulating soil biology
 - About 500 gm/ha!!!
- 3. Plant Growth Regulators gibberellic acid
 - 75,000 litres/ha!!!!

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Maxicrop Field Trials (n = 300)



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With a strength

Maxicrop = Water!!!



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Conclusion

It cannot work!

based on its claimed mode of action

It did not work!

based on the field trial evidence

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"Keep the drum - it is the most useful part!"

Prof Walker

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Example 2: Pasture Plus

Mode of action

- Designed to stimulate root activity and turnover by increasing sugar supply
- Enabling better utilisation of soil nutrient and water
- Increases the utilisation of soil P reserves

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- Contains high concentration of multiple nutrients
- Supplies a high does of soil-imobile ions (P).



Pasture Plus

Nutrients (kg nutrient/ha)

	Ν	Р	K	S
Pasture Plus (4 I x 3 appl)	0.7	1.4	0.4	0.4
Hay crop (1 tonne)	40	3	40	3
Maintenance	0	40-50	70-80	30-50

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Water



Review: Liquid Fertilisers

(D C Edmeades 2002. Aust. J. Agric Res. 53: 965-976

Туре	Number of trials	Mean response (%)	Confidence interval
Fish	67	-1.4	1.44
Seaweed	543	1.48	0.88
Animal	93	-1.24	1.69
Vegetable	107	-0.72	1.52

Ave response = 0.6% +/- 0.6% (N= 810)

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Soil Inoculants and Activators (Probiotics)

Claimed to contain:

- Beneficial soil microbes
 - Bacteria, fungi, algae, actinomycetes, protozoa
- Plant Growth Regulators
 - Auxins, gibberrellic acid, cytokinnins
- Plant food
 - Sugars, amino acids, electrolytes etc

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TM21/TM Agriculture

- Increase/stimulates the beneficial native soil biology
- Contains: a range of organic components

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- Not specified
- Apply at 250 ml/ha
- Two reports inconclusive

<u>Successes</u>

- Bacteria rhizobia legumes
- Kodiak[™] bacteria (suppresses root pathogens in wheat)

<u>Failures</u>

- Mycorrihizal fungi
- New more efficient rhizobia
- Free living N fixers

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1. 1980

Literature Review

(D C Edmeades unpublished)

Ave response = 1.0% (n = 153 trials)

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Questions for the Salesman

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Test 1: Mode of Action

- How does the product work?
- What are the active ingredients in the product
- How much active ingredient is in the product when applied as recommended

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Test 2: Credibility Test

Be wary if promotional material contains:

- Doomsday message
 - Conspiracy theory
- Reliance on farmer testimonials
 - Natural product
- Ahead of science beyond science
 - Requires a new paradigm
 - Developed by a lone genius

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Test 3: Evidence

- What are the claims?
 - Beware of products with multiple claims.
- Where is the supporting evidence?
- Is it in a reputable peer reviewed science publication?

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- If not, who conducted the trial?
- Was the trial properly designed?
- Is there supporting evidence?



Test 4: Common sense

• If the claims are true why is not every farmer using it?

"If it sound to good to be true it probably is."

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Dr John Roche

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Thank you

"The only antidote to pseudo – science is science itself"

Carl Sagan

www.agknowledge.co.nz/publications/Fertiliser Review

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Organic farming

- Based on a pre-science (pre 1850s) myth
 - Organic matter is not the 'life force' of the soil.
- Production from organic systems is about 60% of conventional systems.
- Organic food is not healthier than conventional food.
- Organic fertilisers are no better or worse than chemical fertiliser in terms of soil quality
- Organic systems are no better for the environment



EFFECT OF SUPER AND STOCKING RATE ON WOOL PRODUCTION (kg greasy/ha/yr)

(Carter and Day 1970)

STOCKING RATE	SUPERPHOSPHATE (kg/ha/yr)			
	94	189	282	
6 (merino/ha)	63	67	68	
8	80	81	83	
10	87	96	99	

Note : significant super x SR interaction -ie bigger benefit from fertiliser at higher SR

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POTASH AND CLOVER GROWTH

PROPORTION OF	CLOVER	(%)
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SUPER	POTASH (kg/ha/yr)			
(kg/ha/yr)	0	125	250	375
0	0	0	0	1
187	27	36	43	50
375	22	46	58	56
562	34	40	67	61

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From Wright et al 1975

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Liming Materials

Calcium or Magnesium carbonate (Ca) + (Mg) + (CO₃)

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Active ingredient Neutralizes soil acid

Note: 1) Ca and Mg do not change the soil pH

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Active ingredient: carbonate

Two things we need to know:

1. How much is present?

• Neutralizing value (High = greater pH change/tonne)

2. How available is it?

• Particle size (Small = faster acting)

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<u>Lime</u>

- Subsoil acidity?
 - Can be solved by surface
 application given time
- Little and often or big and infrequent?

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LIME & ANIMAL PRODUCTION (Wagga Wagga, Dept Agric, Dr Li)

Measurement	No lime (pH =4.5)	Lime (pH = 5.5)
Pasture (kg DM/ha/yr)	4861 ¹	$5493^{1}(13\%)^{2}$
Stocking Rate (sheep/ha)	15.6 ³	18.9 ³ (21%)
Liveweight gain (kg/ha)	279^{3}	355 ³ (27%)
Greasy wool (kg/ha)	74.2^{3}	90.7 ³ (22%)

Notes 1) means over annual and perennial systems and crop rotations over years 1993-1997

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2) relative response to lime

3) means over annual and perennial systems and crop rotations over years 1993-99





Hamilton Grazing Trial (mean of 3 stocking rates

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Reactive Phosphate Rocks (NZ Experience)

- Introduced 1985
- Alternative to soluble P (super, DAP, Triple super)
- Claimed to be as agronomically effect as soluble P
- Where (at that time) cheaper

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