Fact or Fiction?

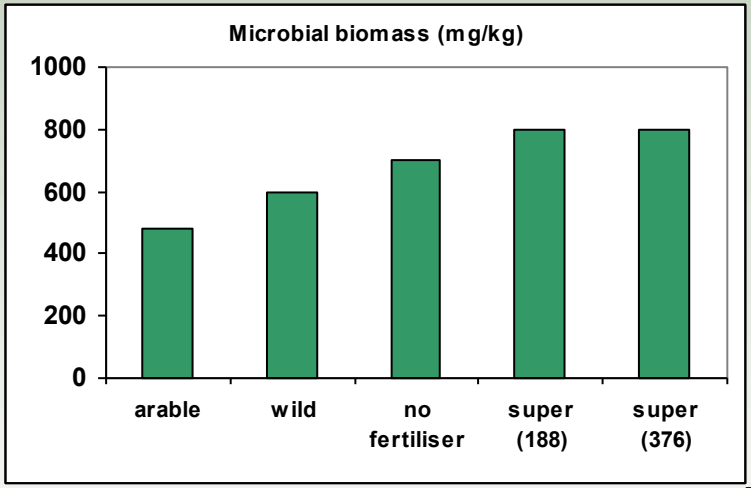
Optimizing the fertiliser $$$?
Questions for the fertiliser salesman?

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

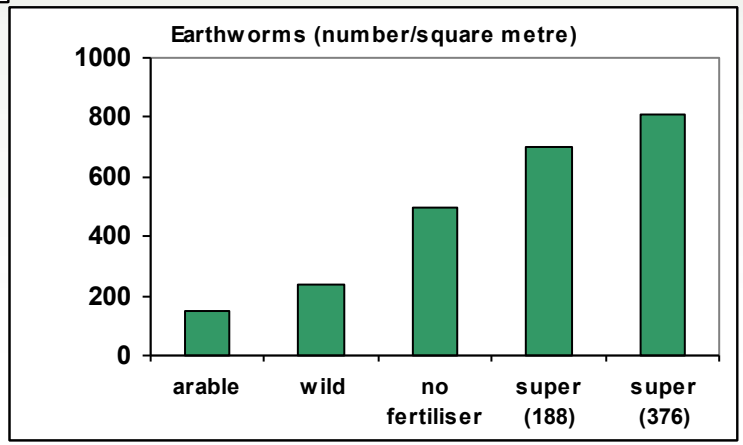
Part One

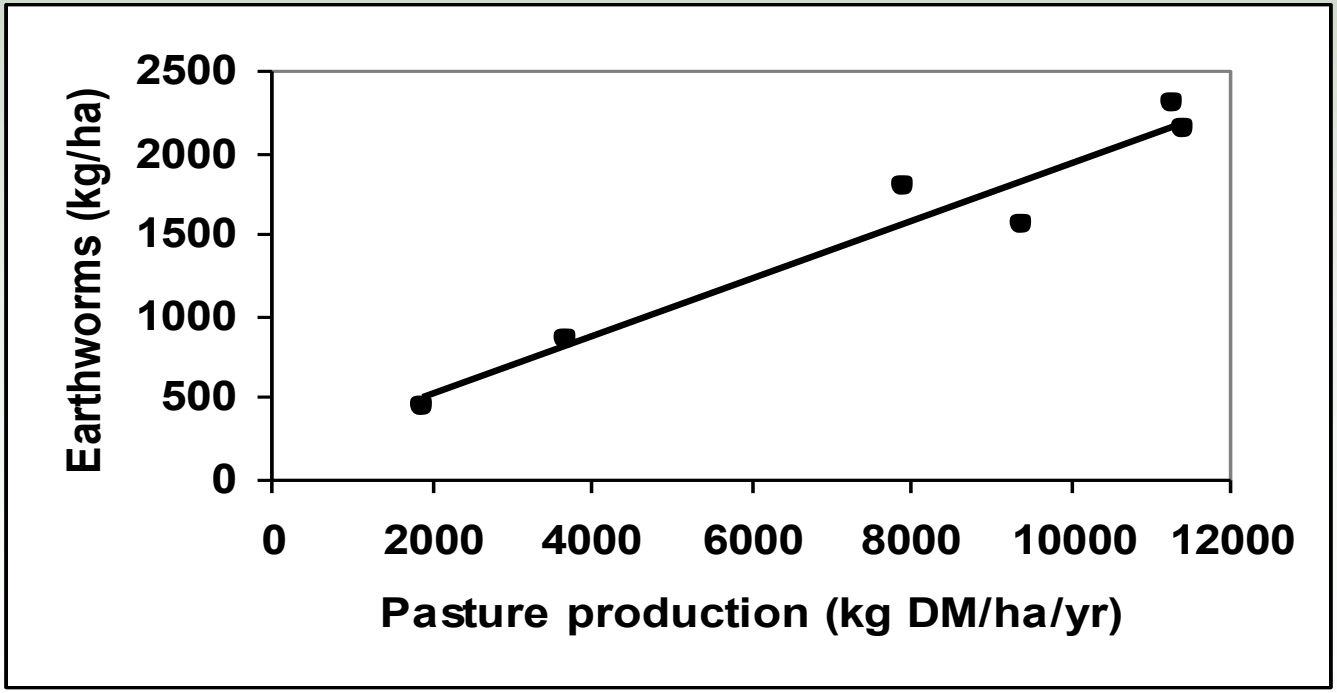
Some Principles

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



Winchmore long term trial




Earthworms (kg/ha)
2500
2000
1500
1000
500
0
0
2000
4000
6000
8000
10000
12000
Pasture production (kg DM/ha/yr)

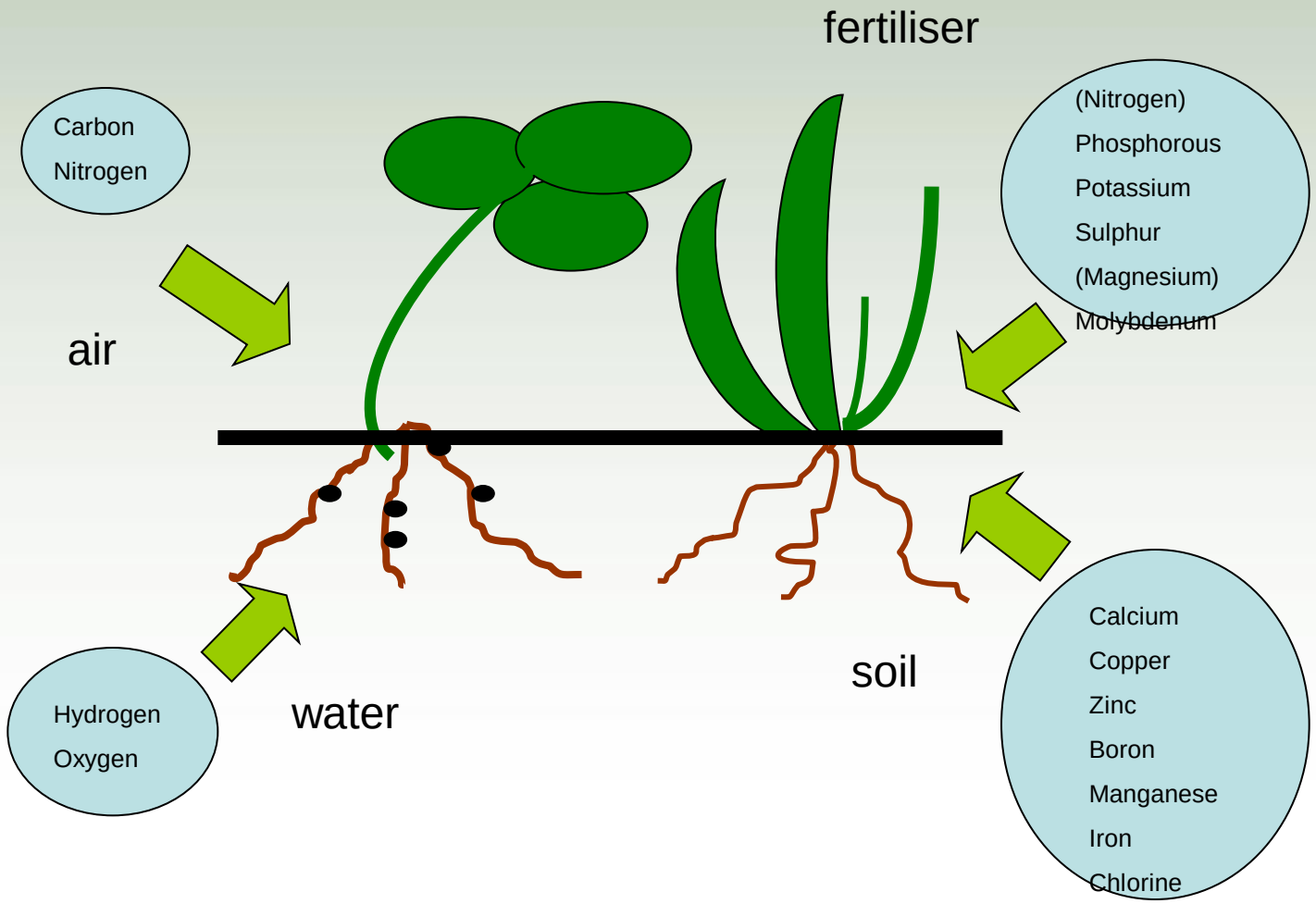
Soils Do Not Make Nutrients

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

Plants Need

16

nutrients

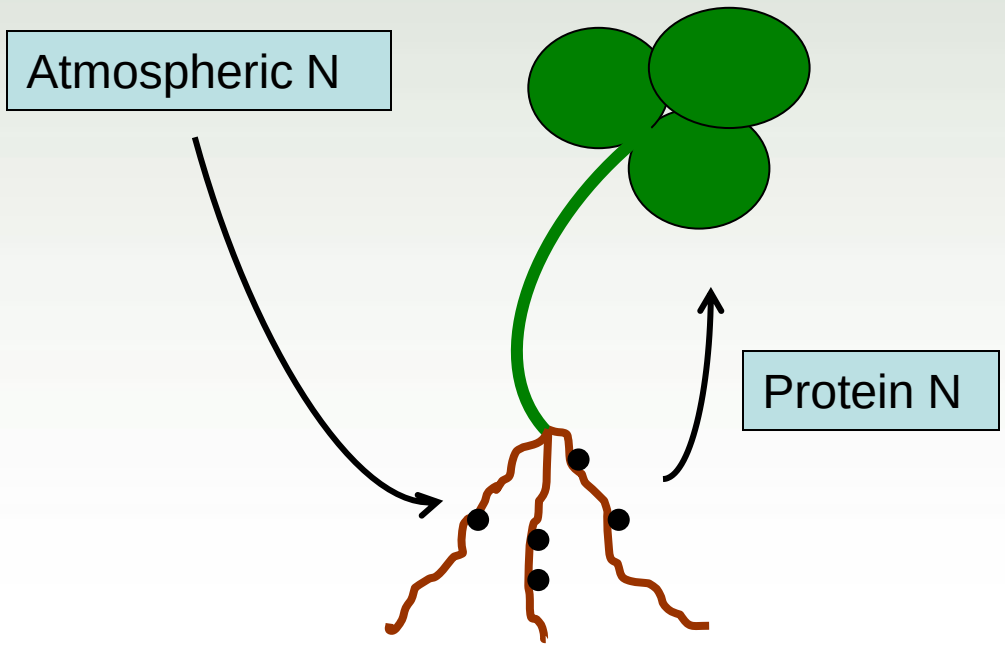

fertiliser
Carbon
Nitrogen
air
(Nitrogen)
Phosphorous
Potassium
Sulphur
(Magnesium)
Molybdenum
Hydrogen
Oxygen
water
soil
Calcium
Copper
Zinc
Boron
Manganese
Iron
Chlorine

Von Liebigs
Law of the Minimum (circa 1850)

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

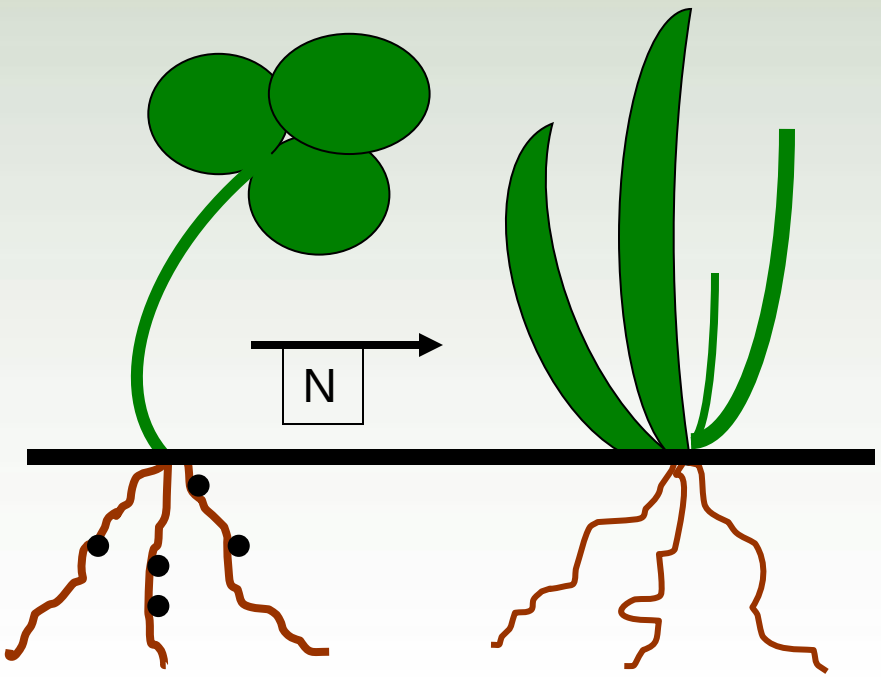
e.g. Applying more super (P + S) on a K deficient soil is a waste of money

CLOVER *is* KING



Free Nitrogen & better Stock Food

Legume-based system



Cheapest feed on the planet

4-5 cents per kg dry-matter

BUT

Clover has a higher requirement for all nutrients!

If clover growth poor then there is a soil fertility limitation

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?

Diagnosing Soil Nutrient Problems

Beware!!!

Vagaries of soil testing

Easy to get inflated/wrong results

Best Practice

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

Critical Clover Concentrations

P = < 0.3%

K = < 2.0%

S = < 0.25%

Mg = < 0.15%

Ca < < 0.20%

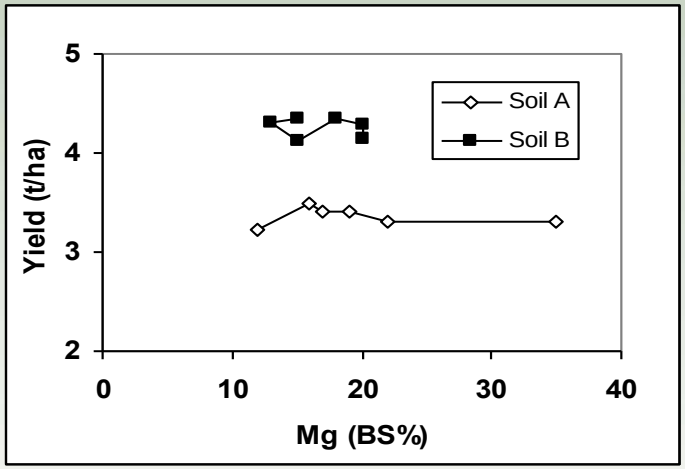
Mo < 0.10 ppm

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

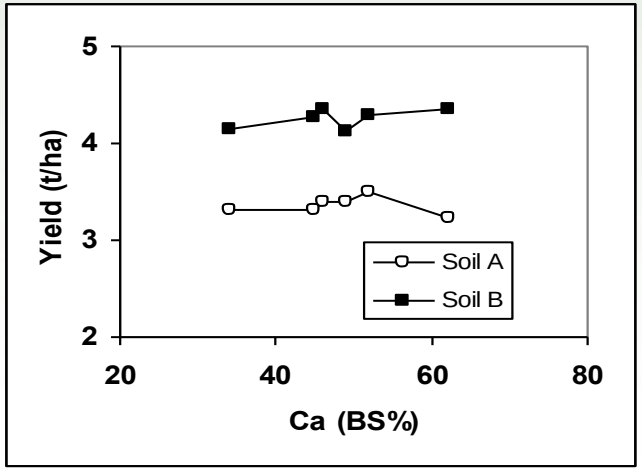
Alternative Soil Testing Methods

BCSR Theory/Albrecht

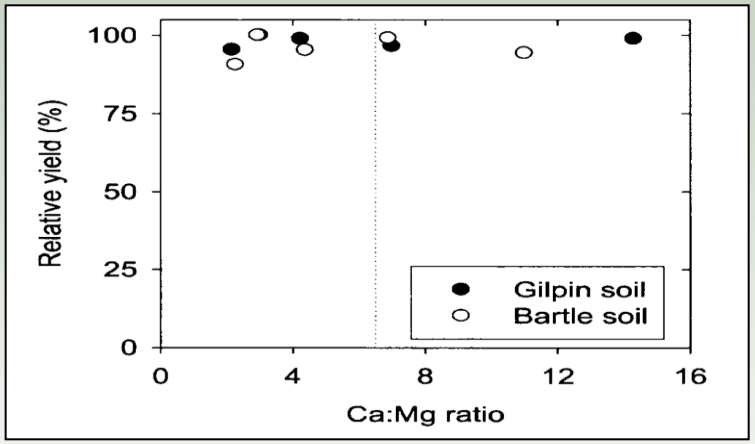
- 1930s: 2 emerging theories of plant nutrition:
  - Quantity Theory – minimum amount of each nutrients required (applies to all 16 nutrients)
  - Ratio Theory – need to have correct ratio of nutrients (applies only to the cations Ca, Mg, K and Na)



lucerne

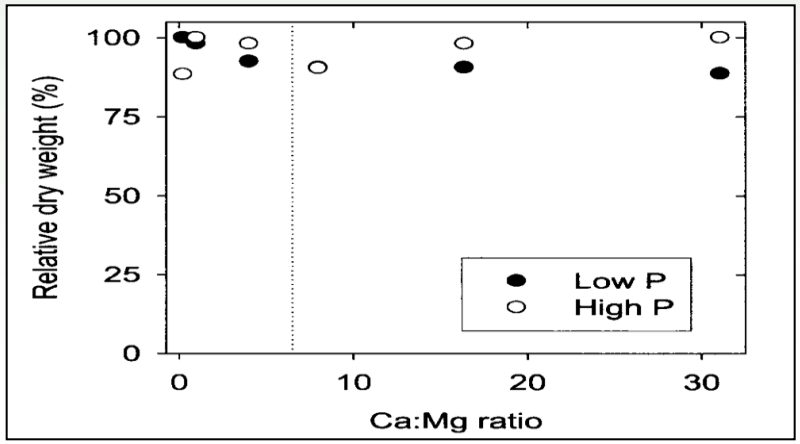


From Schulte & Keeling 1989



Millet on 2 soils

Lucerne at 2 levels of P



From Kopitte and Menzies 2007

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

Part 2:
Fertiliser Products

Liquid or Solid Fertilisers?

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

Mean 4 trials on nutrient deficient soils

Form of Product

Solid? – Suspension? – Liquid?

The plant does not care!

Forget about

- foliar feeding
- soil P fixation

Qualification: except on calcareous soils

Same applies to organic or chemical fertilisers

Best Advice

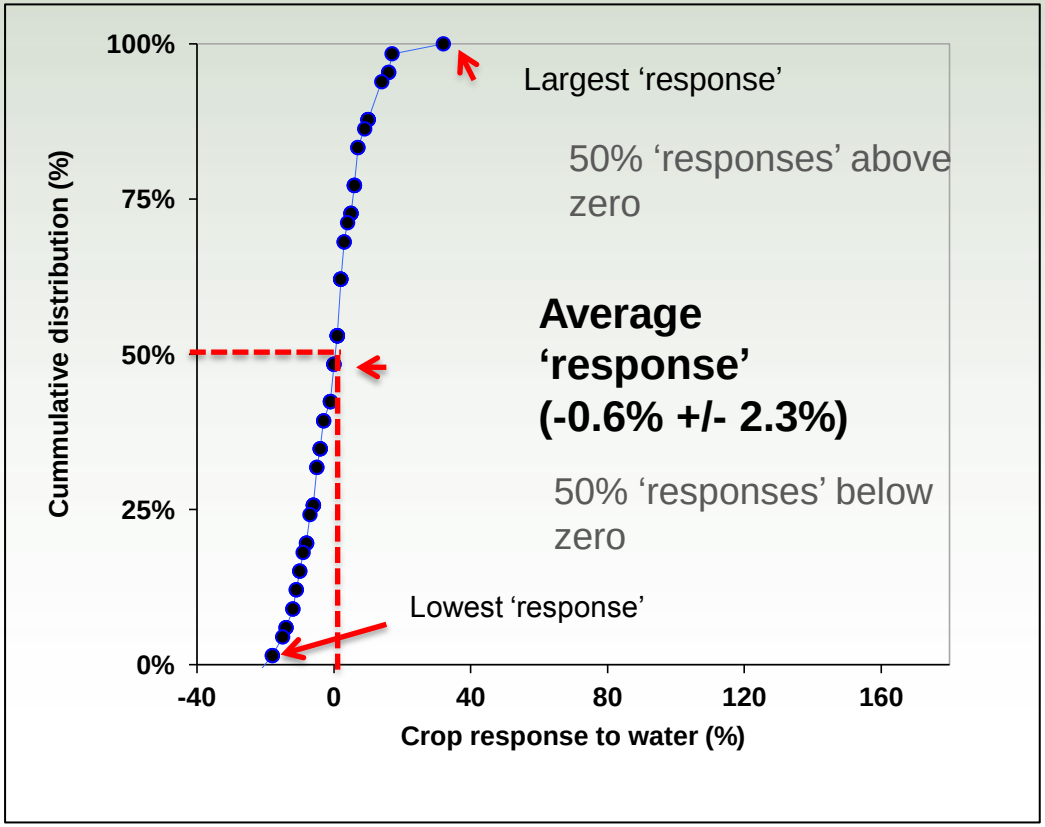
- Calculate the amounts of each nutrient required
- Choose the least-cost product(s) to do the job.
    - Whether chemical or organic, or solid or liquid.
-

Interpreting Field Trial Results

Background Noise in Field Trials

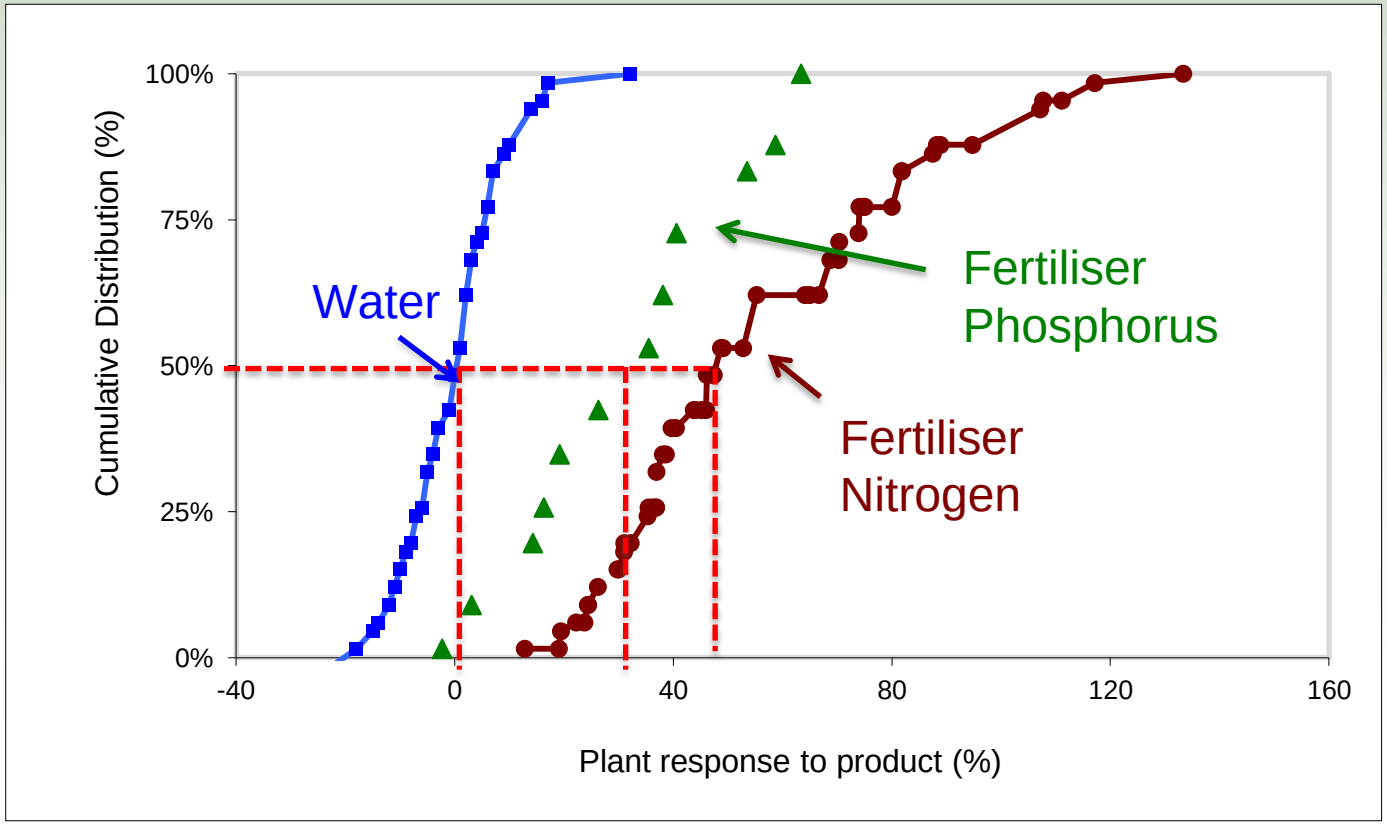
- UK scientist measured: control v water (225 l/ha) on crop production.
- This amount of water will have no agronomic effect on crop growth.
- There were 66 trial-years of data covering a range of crops.

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



This is what the background noise looks like

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



Example 1: Maxicrop

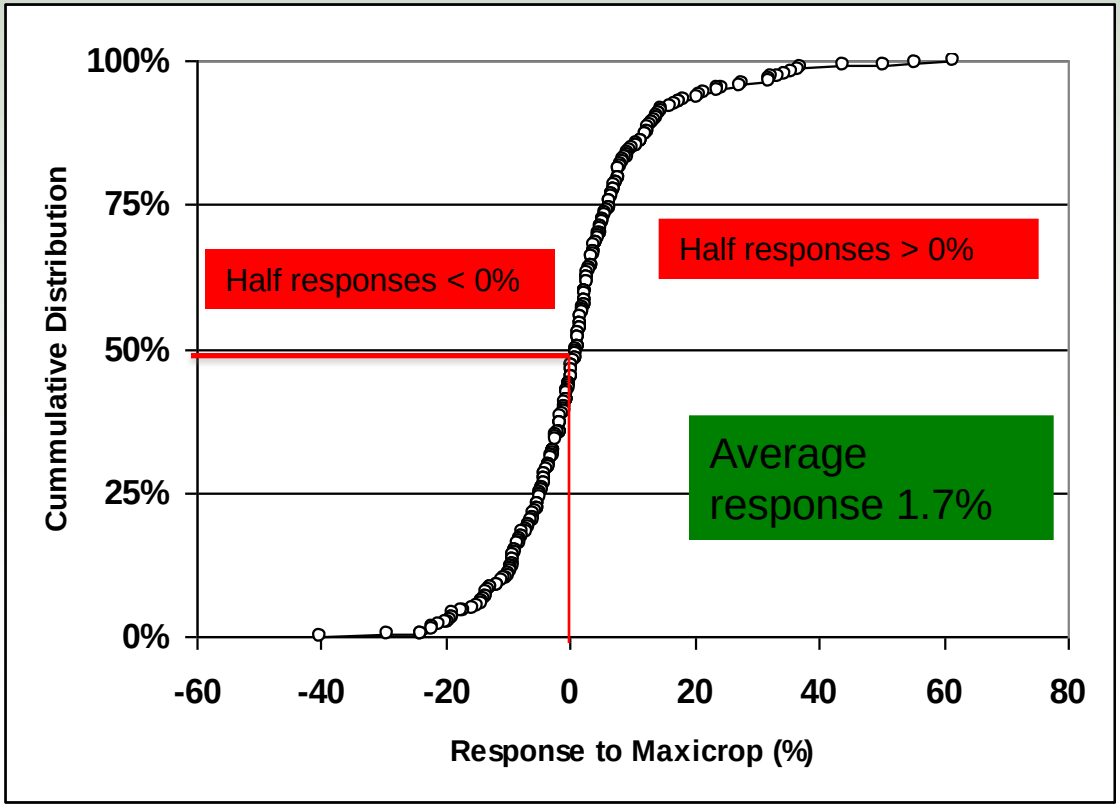
Background

- Liquid fertiliser – seaweed extract
- Typically applied 10 l/ha
- Claims – many

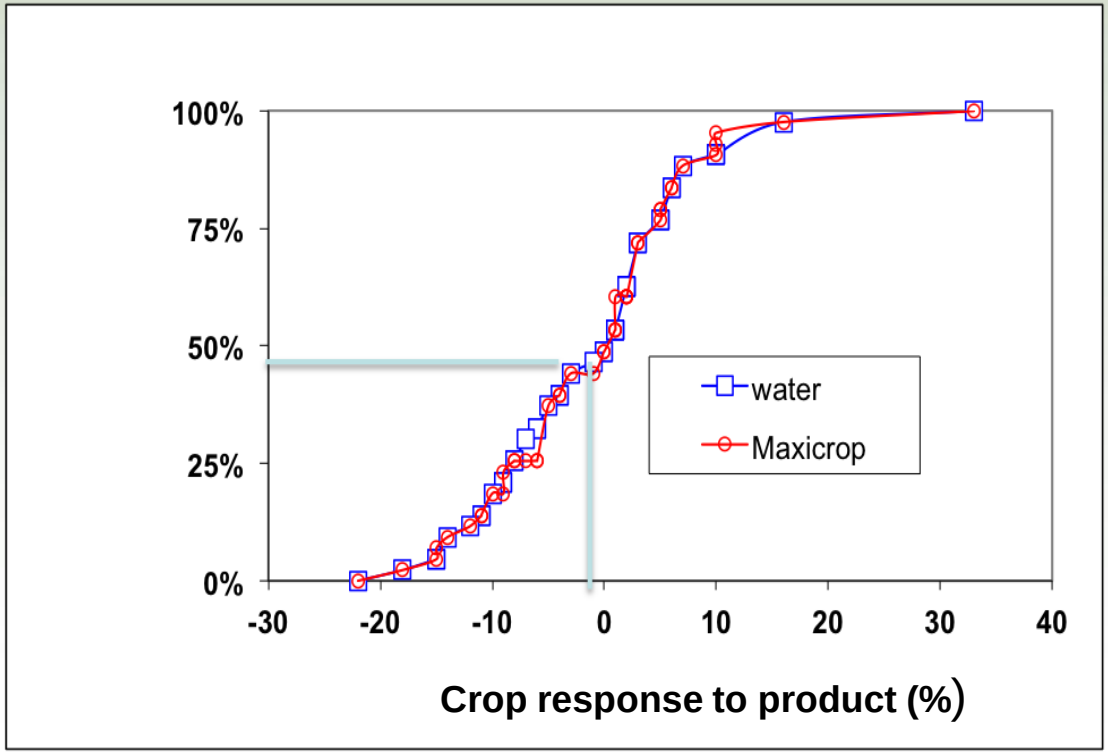
Claimed mode of action

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!!!!

Maxicrop Field Trials (n = 300)



Maxicrop = Water!!!



Conclusion

It cannot work!

- based on its claimed mode of action

It did not work!

- based on the field trial evidence

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

Prof Walker

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

Pasture Plus

Nutrients (kg nutrient/ha)

	N	P	K	S
Pasture Plus (4 l 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

Review: Liquid Fertilisers

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

Type	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)

Soil Inoculants and Activators (Probiotics)

Claimed to contain:

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

TM21/TM Agriculture

- Increase/stimulates the beneficial native soil biology
- Contains: a range of organic components
    - Not specified
- Apply at 250 ml/ha
- Two reports - inconclusive

Successes

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

Failures

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

Literature Review

(D C Edmeades unpublished)

Ave response = 1.0%

(n = 153 trials)

Questions for the Salesman

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

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

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?
- 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.”

Dr John Roche

Thank you

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

Carl Sagan

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

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

POTASH AND CLOVER GROWTH

	PROPORTION OF CLOVER (%)			
SUPER (kg/ha/yr)	**POTASH (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

From Wright et al 1975

Liming Materials

Calcium or Magnesium carbonate

(Ca) + (Mg) + (CO_3)

Active ingredient

Neutralizes soil acid

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

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)

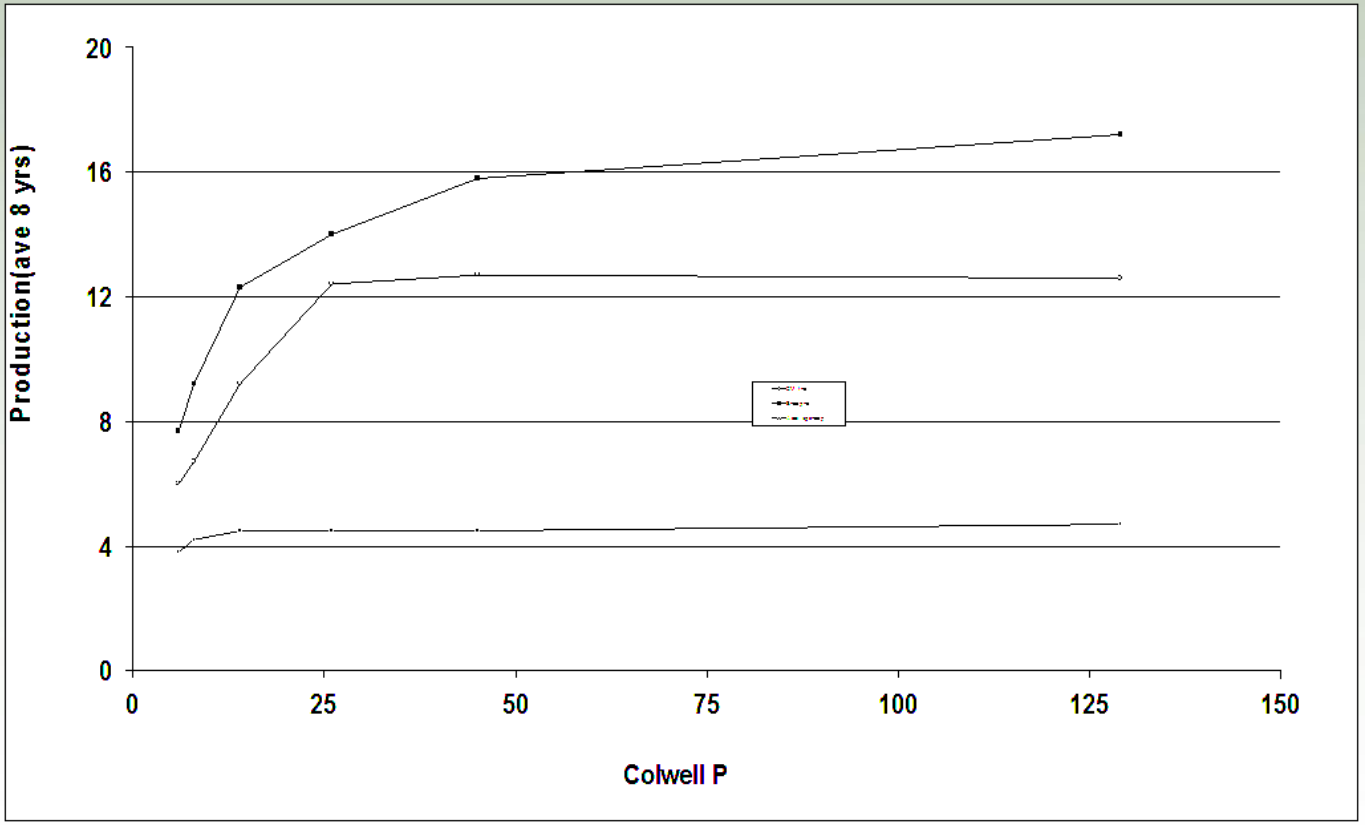
Lime

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

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
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

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