Managing high nitrogen fertiliser prices and limited supply

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Introduction

- Nitrogen fertiliser prices
- Soil testing for nitrogen
- Adding organic forms of nitrogen
- Availability of organic nitrogen
- Fertiliser practices
- Improving nitrogen use efficiency
- Grower and adviser panel

Fertiliser prices (supply & demand)

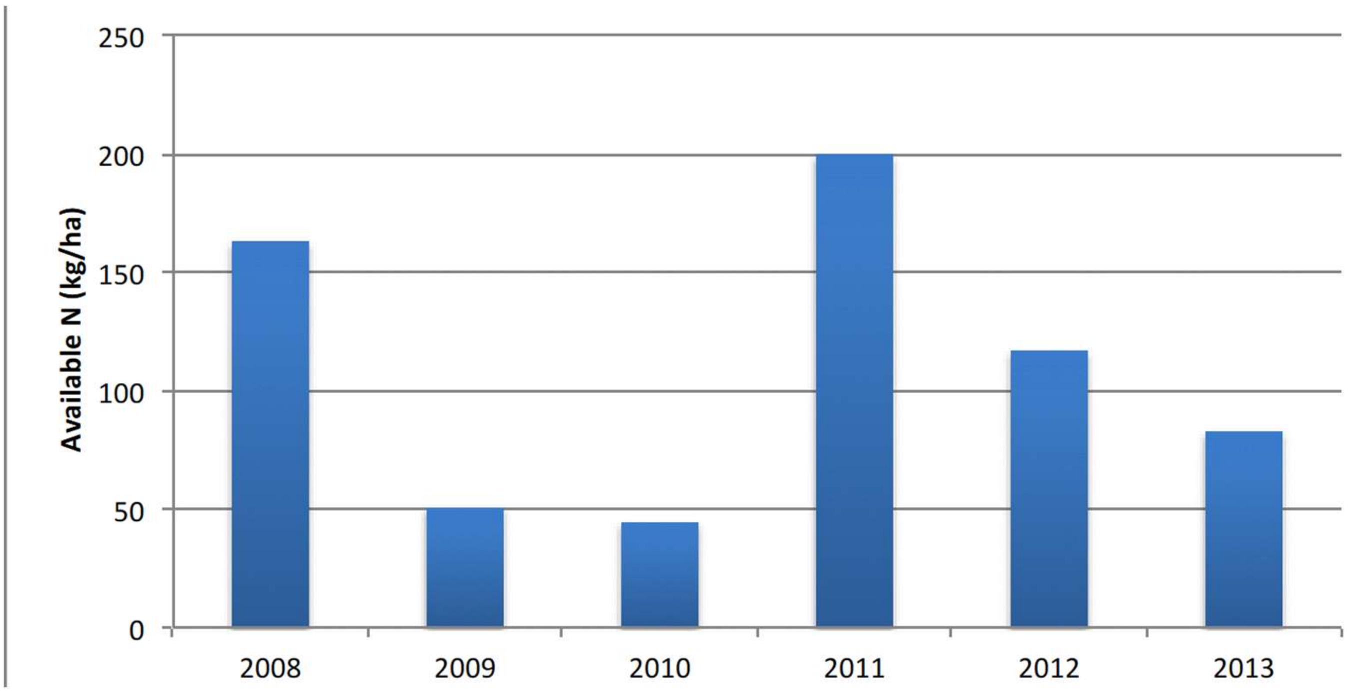
- Current nitrogen cost: ~ $3 - $3.50 / kg N
- Current phosphate cost: ~ $6 - $7.00 / kg P

ROI to N & P applications has dropped

1. Russia: US$7 billion (12.7% of total exported fertilizers)
2. China: $6.6 billion (12%)
3. Canada: $5.2 billion (9.4%)
4. United States: $3.7 billion (6.7%)
5. Morocco: $3.4 billion (6.2%)
6. Belarus: $2.6 billion (4.7%)
7. Netherlands: $2 billion (3.7%)
8. Belgium: $1.6 billion (2.9%)
9. Qatar: $1.3 billion (2.4%)
10. Saudi Arabia: $1.2 billion (2.3%)
11. Egypt: $1.2 billion (2.1%)
12. Israel: $1.2 billion (2.1%)
13. Oman: $1.1 billion (2%)
14. Germany: $1 billion (1.9%)
15. Spain: $996.5 million (1.8%)

Pre-plant soil nitrogen test

- Invest in soil nitrogen testing ≈ $35
- Know, don't guess your pre-plant available nitrogen



Legumes

160 – 200 kg/ha of nitrogen - **$500-600 of N/ha**

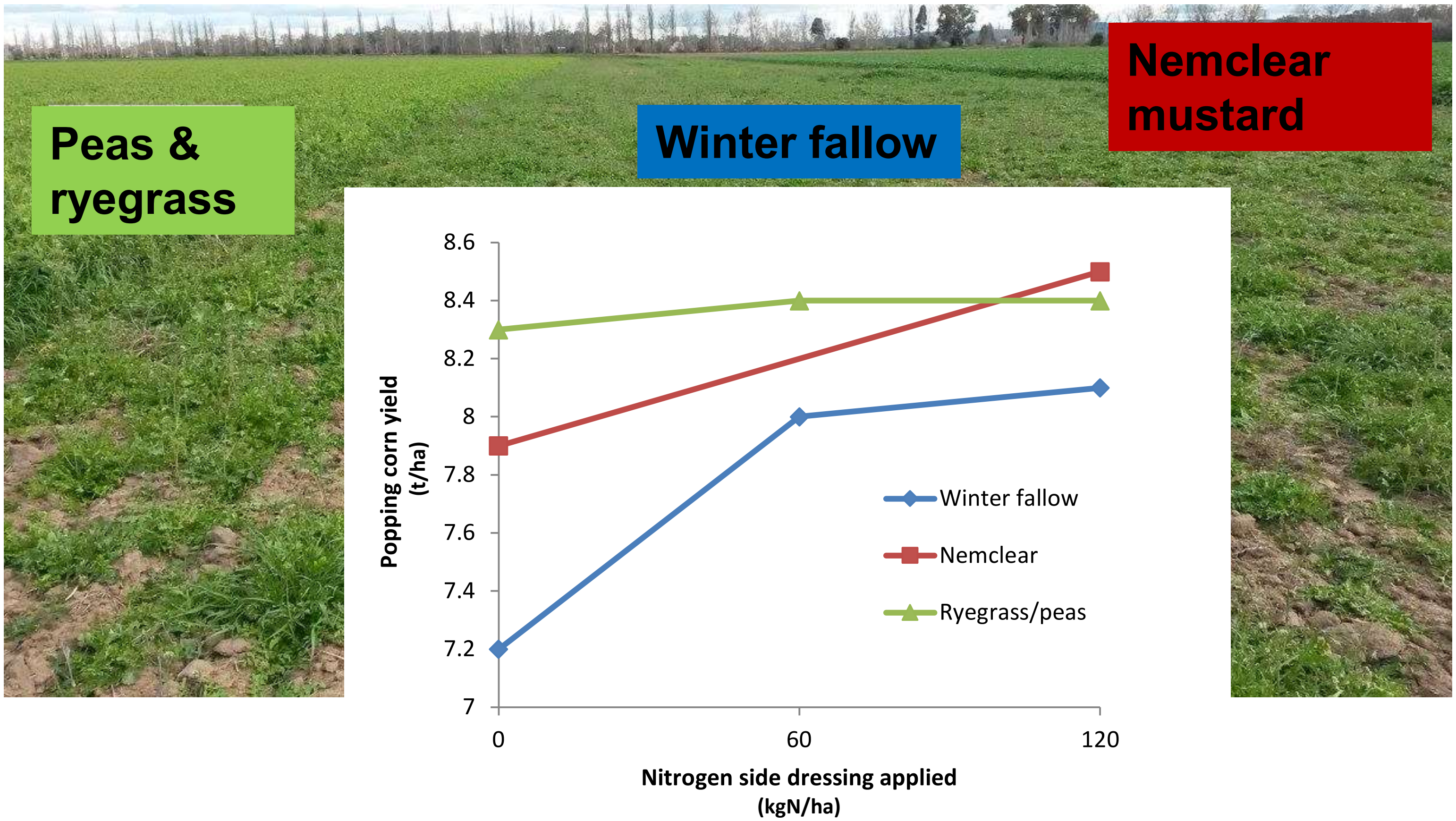
Inoculate!

Legume biomass is king - 20KgN/t legume DM

High soil nitrate >50kgN/ha go with a scavenging cover crop

Have seed in the shed – inoculant in the fridge

Recovering-storing nutrients



Composts

Compost is a soil conditioner, not a fertiliser

Compost can add some nutrients to the soil, depending on feedstock

- Know how much and adjust crop nutrition plans (amount, balance)
- Consider the C:N ratio - this influences the timing of N availability
- Slow release - consider longer term benefits over the rotation

Compost can reduce need for fertilisers - via *better rooting depth,* nutrient holding capacity (structure) and nutrient cycling (microbiology)

Manures

- Animal manure has to be composted to be (food) safe

"Soil additives containing animal manure are not recommended for short-term crops with edible skins, such as leafy vegetables and herbs."

Follow your food safety QA scheme guidelines!

- Comments made for compost apply:
  - checking nutrient content and including it in the crop nutrient budget
  - checking C/N ratio

Compost & manure challenges to manage

- Variability
- Unknown feedstock = unknown nutrient content
- Costs of transport and spreading
- Uneven or over application
- Unbalanced nutrition
  - Nutrient composition does not match crop needs
  - Only a small proportion of any nutrients are available straight up
  - Uncontrolled release of N and P can occur
  - P accumulation in soils can occur if manure is a feedstock
  - Lack of Ca and trace elements with continued use is possible
  - Potential C/N effects – N draw down

Australian Standard AS4454 (2012)
composts, soil conditioners and mulches

Pasteurisation

>55^{o}C for at least 3 consecutive days

'Appropriate' turning to achieve the required exposure

If compost feedstock contains manures, animal, food and or grease trap waste:

>55^{o}C for 15 consecutive days or longer and

The windrow shall be turned at least 5 times during that period. This is consistent with the US EPA 503 Rule.

Apply the above rule if feedstocks are not known

Maturation – at least 6 weeks

Batch analysis required as per Standard

Availability of Organic N

…Biology Drives the System

- Previous residues & inputs

(Decomposition rates**)**

- Soil organic matter

(soil test, understand environment)

- Soil **Temperature** (25C – 32C ideal)
- Soil **Moisture** (50 – 60% ideal)
- Soil constraints (compaction, waterlogging)
- pH – mineralisation is slower in acidic soil (below 5.5 CaCl)

Decomposition rates of crop residues, organic inputs

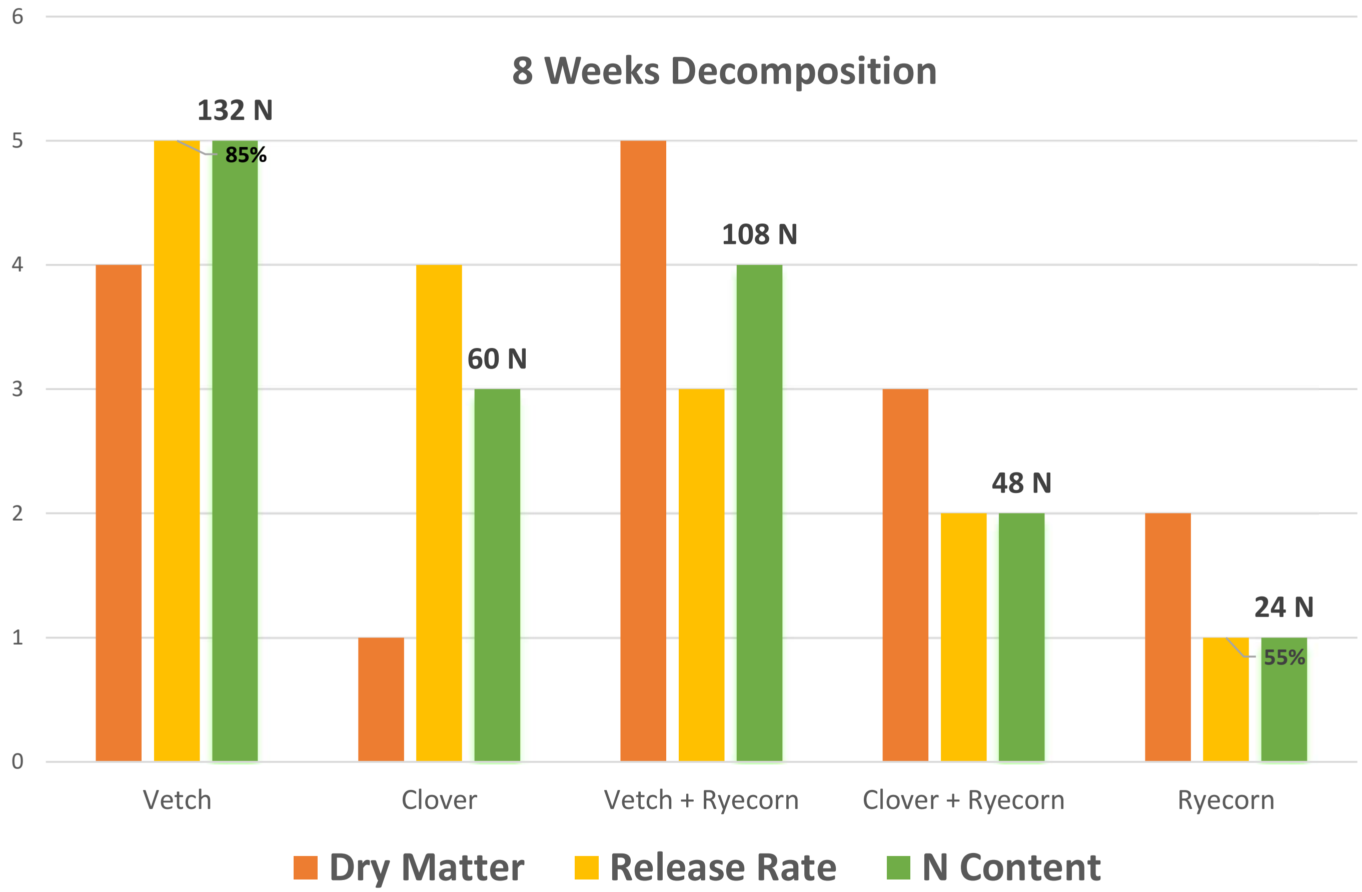
Integrated Crop Protection
PROTECTING CROPS
Soil Wealth
NURTURING CROPS

Organic matter material	C:N ratio	
Ryecorn straw (grain harvested)	80:1	SLOWER
Corn stalks (no cobs)	60:1	
Ryecorn cover crop (anthesis)	40:1	
Pea straw (peas harvested)	30:1	
Ryecorn cover crop (early jointing)	26:1	
Lucerne hay - old (stems)	25:1	Decomposition Rate
IDEAL Microbial Diet	**24:1**	
Rotted feedlot manure	20:1	
Legume hay	17:1	
Cow manure	17:1	
Lucerne hay - young (leaves)	13:1	
Vetch cover crop	11:1	
Soil microbes (average)	8:1	FASTER

Soil organic mater 10:1

- Release of N from (cover) crop residues is a function of C:N ratios (+ environment)
- Increasing soil carbon
  - High C:N ratio stubble will immobilise soil N
  - reduces soil N, therefore more nitrogen is required!

Relative Mineralisation Rates (2 year average)



- Legumes: ~50% nitrogen release in 4 weeks (soybeans)

Noah Ranells Dept of Env SC USA

N availability from soil organic matter

Integrated Crop Protection
PROTECTING CROPS

Soil Wealth
NURTURING CROPS

Analyte	Depth 0 - 15	Depth 15-30
pH (Water)	6.90	6.80
pH (CaCl2)	6.00	5.80
Organic Carbon	1.05	0.76
Amm. Nitrogen (KCl) mg/kg	0.0	0.0
Nitrate N mg/kg	3	4
Phosphorus (Colwell) mg/kg	76.0	41.0
Potassium (Colwell) mg/kg	177	69
Potassium (Amm-acet.) meq/10(	0.5	0.2
Sulfate S mg/kg	4	5
Calcium (Amm-acet.) meq/100g	4.53	4.91
Magnesium (Amm-accet.) meq/1	1.60	1.65
Aluminium (KCl) meq/100g	0.10	0.07
Sodium (Amm-acet.) meq/100g	0.08	0.17
Elect. Conductivity(1:5) dS/m	0.050	0.040
Copper (DTPA) mg/kg	3.10	3.00
Zinc (DTPA) mg/kg	2.00	1.00
Manganese (DTPA) mg/kg	17	19
Iron (DTPA) mg/kg	38	38
Boron (Hot CaCl) mg/kg	0.2	0.2
Cation Exch Cap meq/100 g	6.76	6.98
Calcium / Magnesium ratio	2.83	2.98
Potassium % of cations	6.7	2.6
Calcium % of cations	67.0	70.3
Magnesium % of cations	23.7	23.6
Aluminium % of cations	1.5	1.0
Sodium % of cations (ESP)	1.2	2.4
Elec. Cond. (Sat. Ext.) dS/m	0.50	0.40

Broadacre formula:

- N Kg/ha = OC X .15 X GSR (mm)

OC = Organic Carbon

GSR = Growing Season Rainfall

Rain ex: 85 day crop, 300 mm = 1.05 X **.15** X 300 = 47 kg N (.55 kg N/day)

Irrigation ex: 85 day crop, 300 mm = 1.05 X .**10** X 300 = 31 kg N (.36 kg N/day)

- Tillage – repeated tillage over 2 or more years rapidly reduces soils ability to provide N from its organic N pool.
- Irrigation vs Rain … rainfall more "effective".

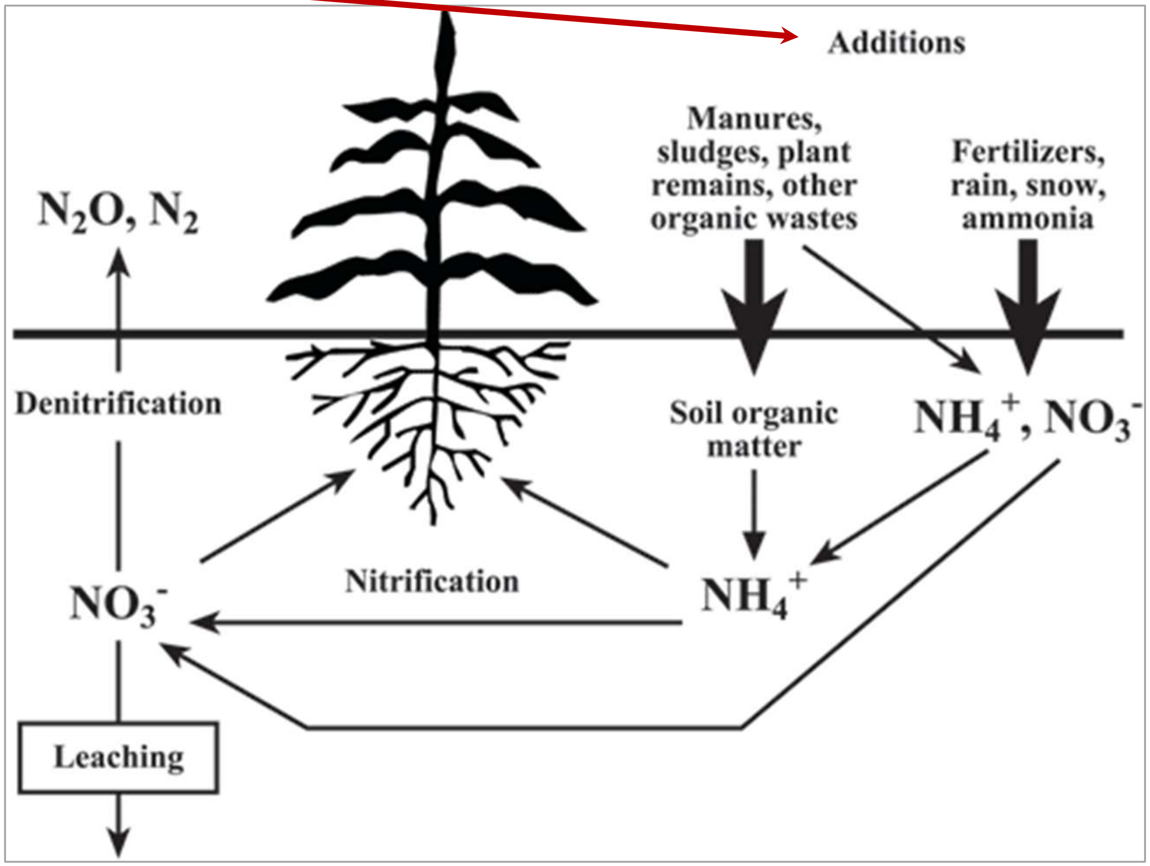
Nitrogen gains and losses

GAINS

- What you add to soils

LOSSES

- What is not used by plants
  - *Ammonia volatilization*
  - *Denitrification*
  - *Leaching*
  - *Surface run-off*
  - *Burning residues*



Source: http://umass.edu/u

NUE% is a partial nitrogen balance

NUE % = N removal by crop / N application x 100

or

NUE % = N removal by crop / (N application + available soil N) x 100

It does not include measured data for:

- Irrigation / rainwater-N
- Soil organic matter mineralisation

  (*e.g. 5 – 30 kg/ha N per % organic carbon in a temperate climate annually*)
- Nitrogen available from previous legume crop
- Nitrogen available from crop residues / incorporated cover crop
- Nitrogen mineralised from organic amendments (e.g. compost).

Measuring (residual) available soil N will estimate the above data.

NUE calculation example

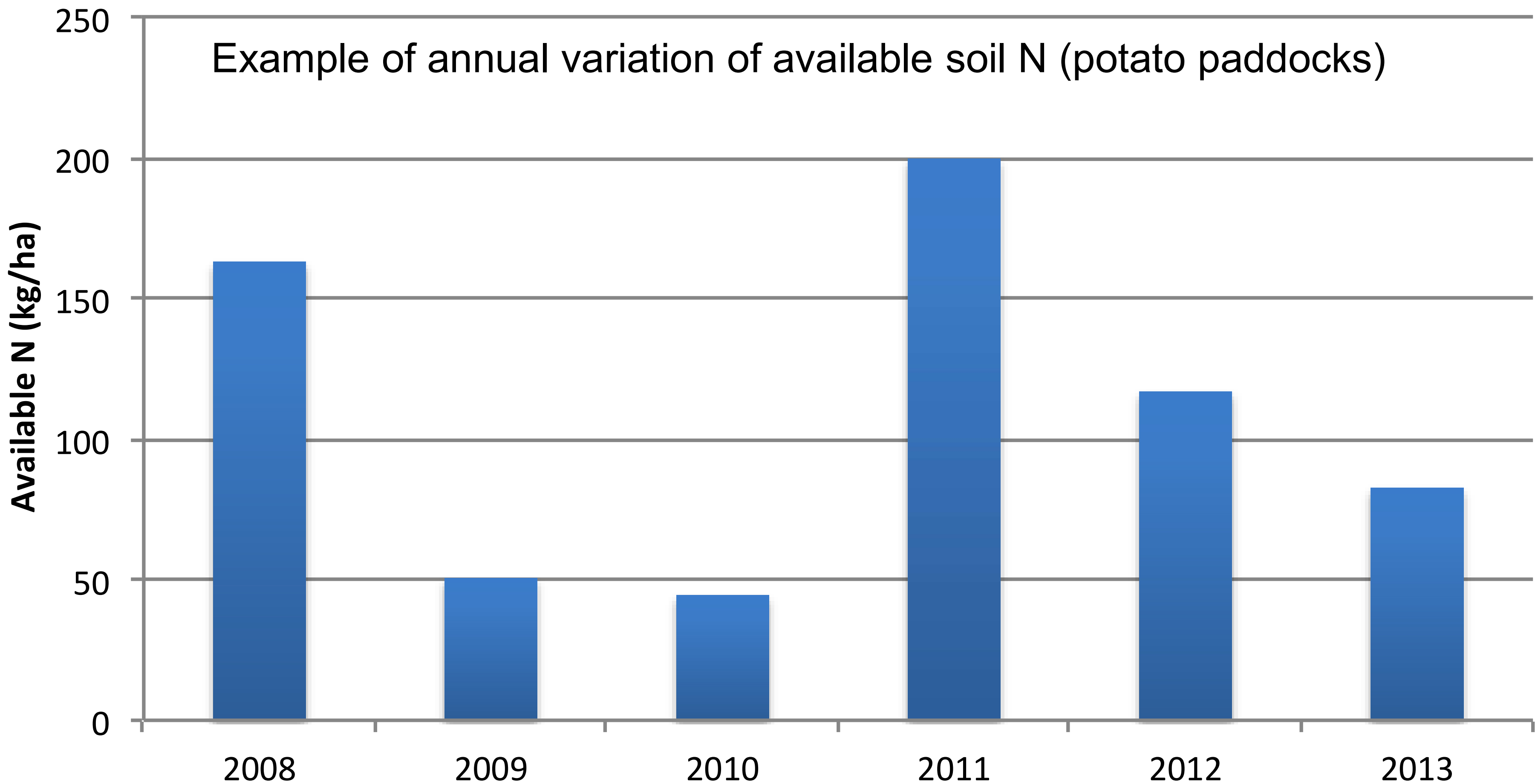
Using NUE % = N removal by crop / N application x 100

Crop	Fertiliser N input [kg/ha] per season	Crop yield (plus / or other plant parts removed [t/ha])	N removal kg N / tonne harvested	N removed [kg/ha]	N use efficiency (NUE) %	Fertiliser N not used [kg/ha]
Lettuce	160	16	2.5	40	**25.0**	120.0
B.Sprouts	300	30	6.5	195	**65.0**	105.0
Celery	300	50	3.5	175	**58.3**	125.0

This estimates the magnitude of N and $$ losses.

Where does it go?

Available soil N, why bother?

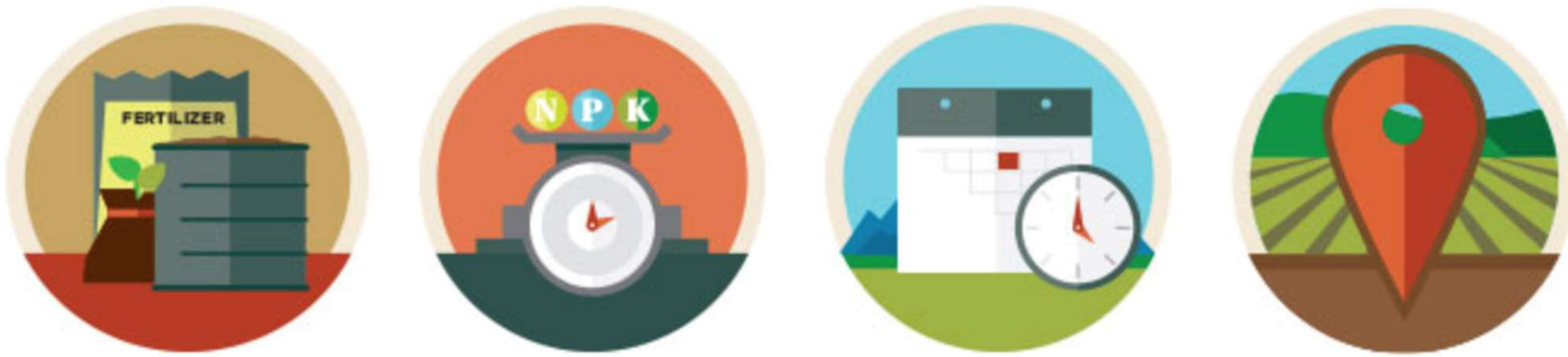


Great variations in available soil N also occur between paddock in the same year

N-check Data: AgVita Analytical

Increase NUE

- Calibrate application gear
- Apply fertiliser 4 R's



RIGHT SOURCE
Matches fertilizer type to crop needs.

RIGHT RATE
Matches amount of fertilizer type crop needs.

RIGHT TIME
Makes nutrients available when crops needs them.

RIGHT PLACE
Keep nutrients where crops can use them.

Increase NUE

- No N fertiliser to waterlogged soils
- No overirrigation
- No soil compaction
- Manage residues (don't burn)
- Use cover crops
- Balance all nutrients

MONITOR
2
MANAGE

Photos: Marcus Hardie, Bill Cotching, Soilquality.org.au

Panel

- Stuart Grigg - Stuart Grigg Ag-Hort Consulting
- Andrew Johanson - Mulgowie Farming Company