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INTERNATIONAL
PLANT NUTRITION
INSTITUTE

GRDC
UPDATES

Addressing in-crop nutrition issues - 2017

Rob Norton, IPNI Regional Director @IPNIANZ

Manangatang, Tuesday July 18, 2017.

Better Crops, Better Environment … through Science

What were the signals from 2016?

- Wet winter & spring
  - denitrification (heavier soils)
  - leaching (lighter soils)
- Relatively high yields – removal of N in grain
  - N residual from high yielding pulses may not be large.
- Heavy stubble loads – immobilization
- Burned stubbles – removal of N in straw

Low N

Mobile S

B deeper

Zinc

Copper

Low P

- 2017 – good break with a dry June – finish cropping!

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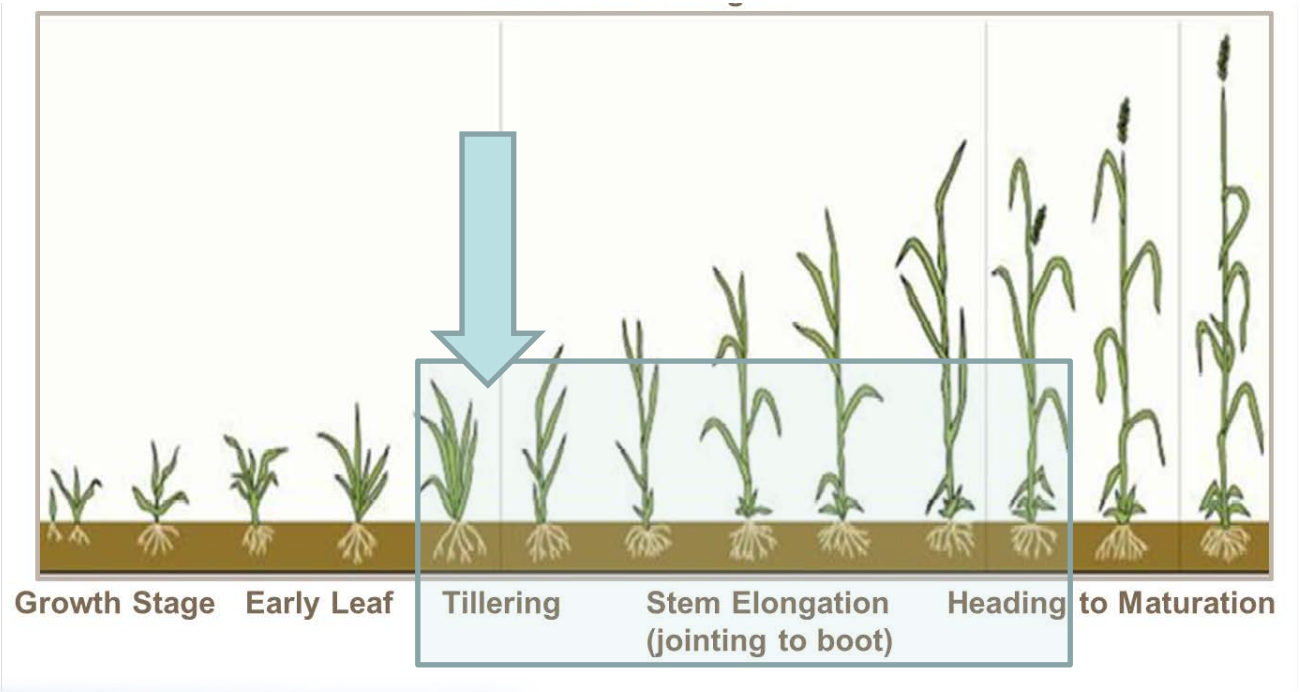
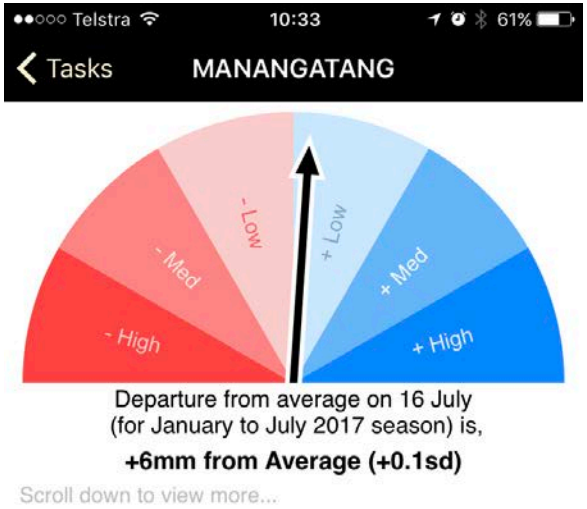
Worry about things you can manage!

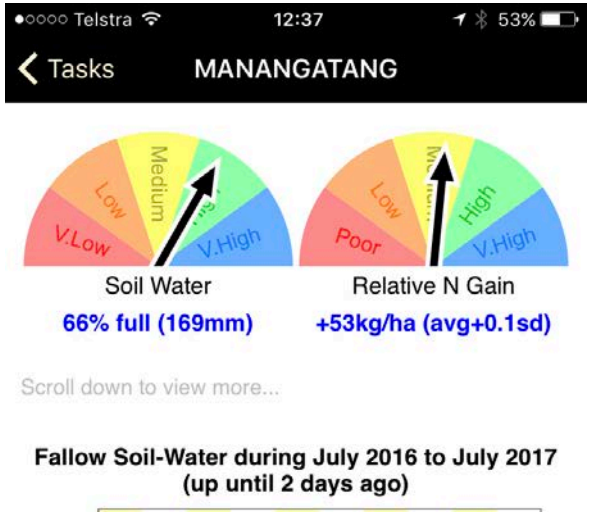


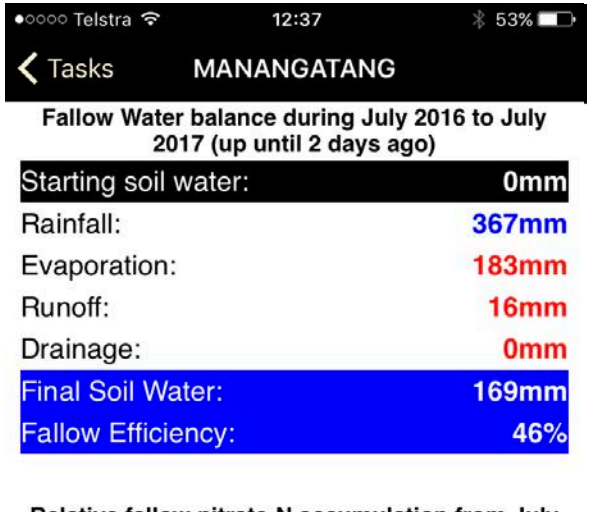
- N, P, K, S, Ca, Mg, B, *Zn*, Mn, Cu, Mo
  X x x x * * * *
- Mobile nutrients – N, S, B profile distribution
- Immobile nutrients – offtake and soil test

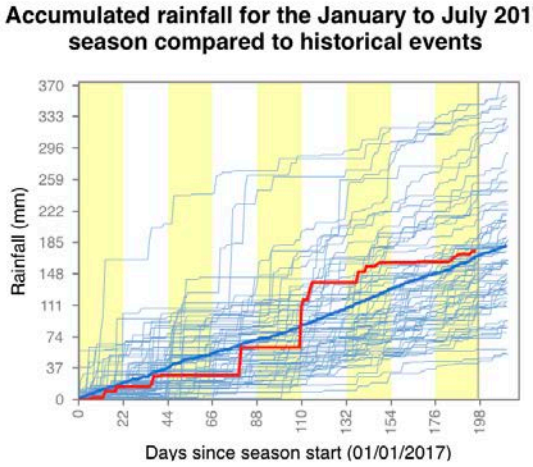
Review and revise….

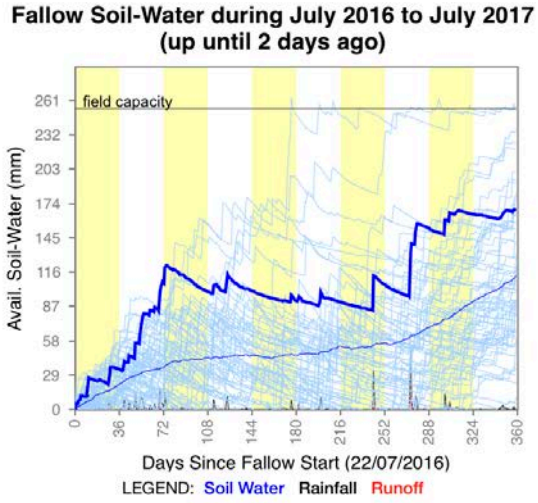
- Season = In Victoria about average even after a dry June.

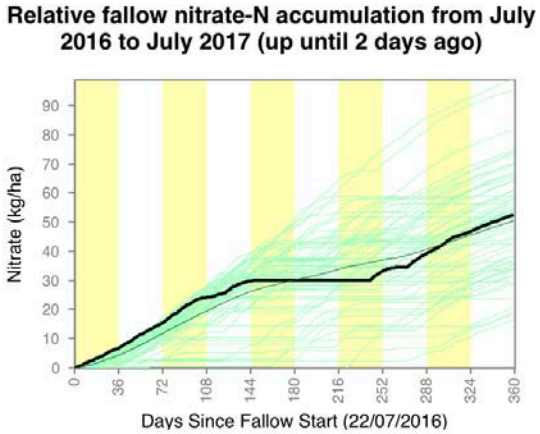










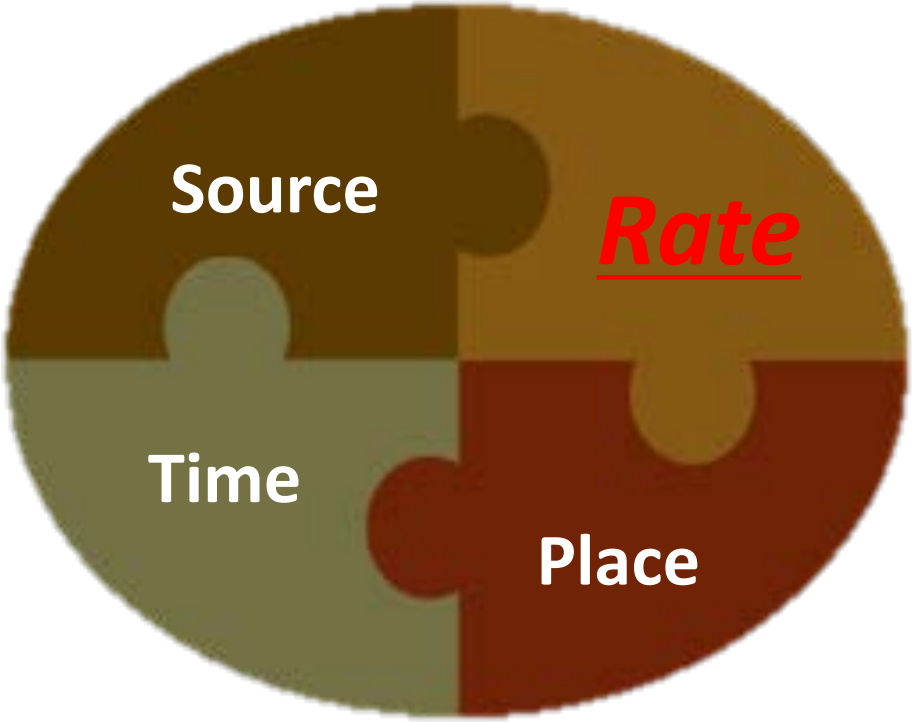


Fallow Water balance during July 2016 to July 2017 (up until 2 days ago)

NOTE: This simple estimate of Nitrate accumulation is based on soil organic matter, daily temperature and surface moisture. It is important to consider this estimate as a measure of departure from the long term average (all years). It does not consider previous crops or weeds.

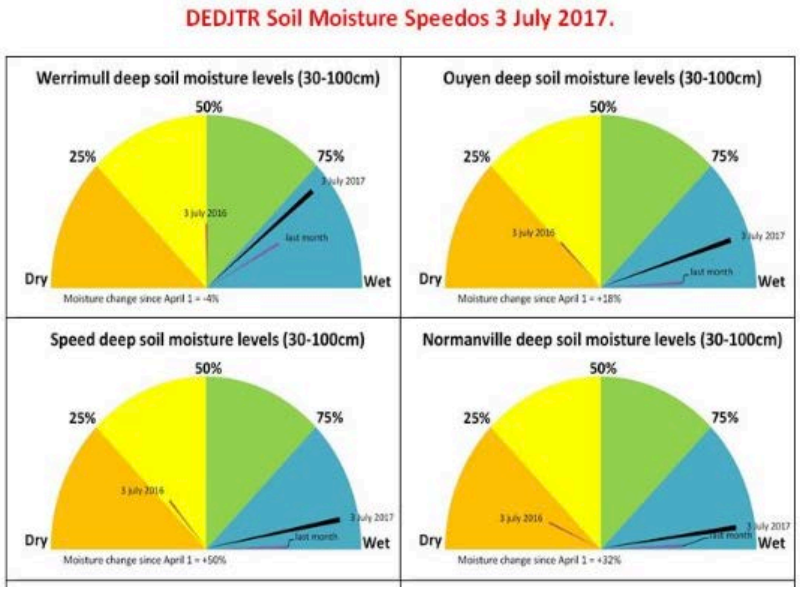
N is – *again* – the big ticket item.

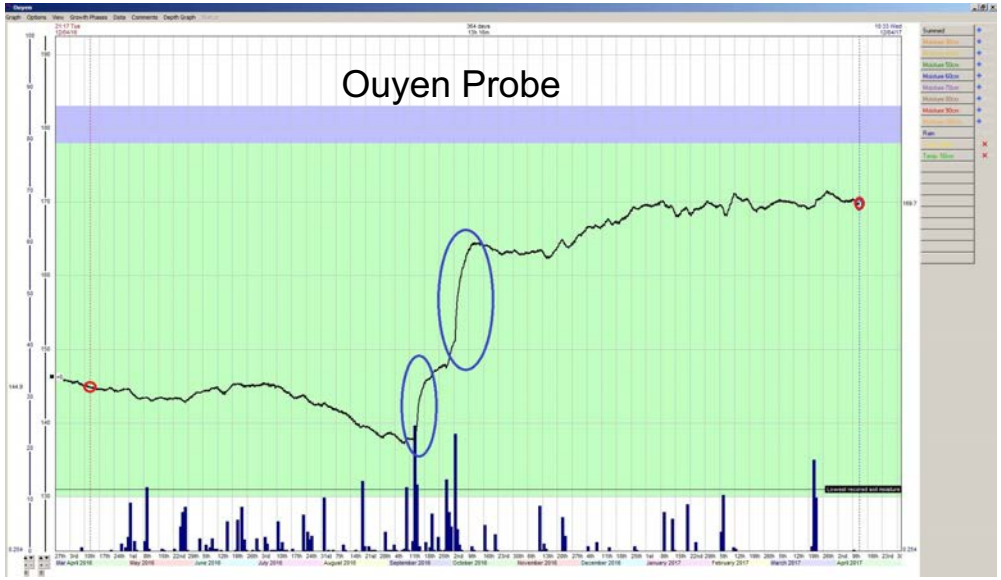
- 4R nutrient stewardship – select the RIGHT source, apply it at the RIGHT rate, at the RIGHT time and in the RIGHT place.



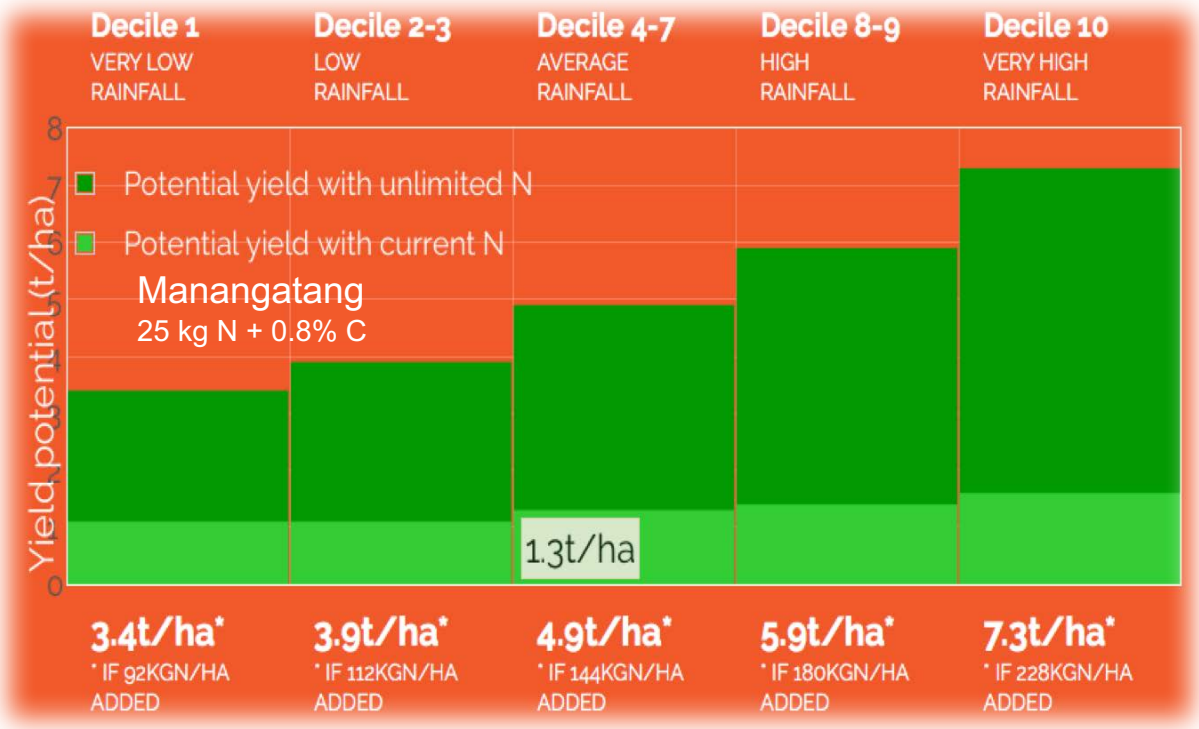
Rate is set by water + Mineral N + Risk

- **Does the crop really need the extra N?**





http://www.yieldprophet.com.au/yplite/



WUE = 20 kg/ha/mm

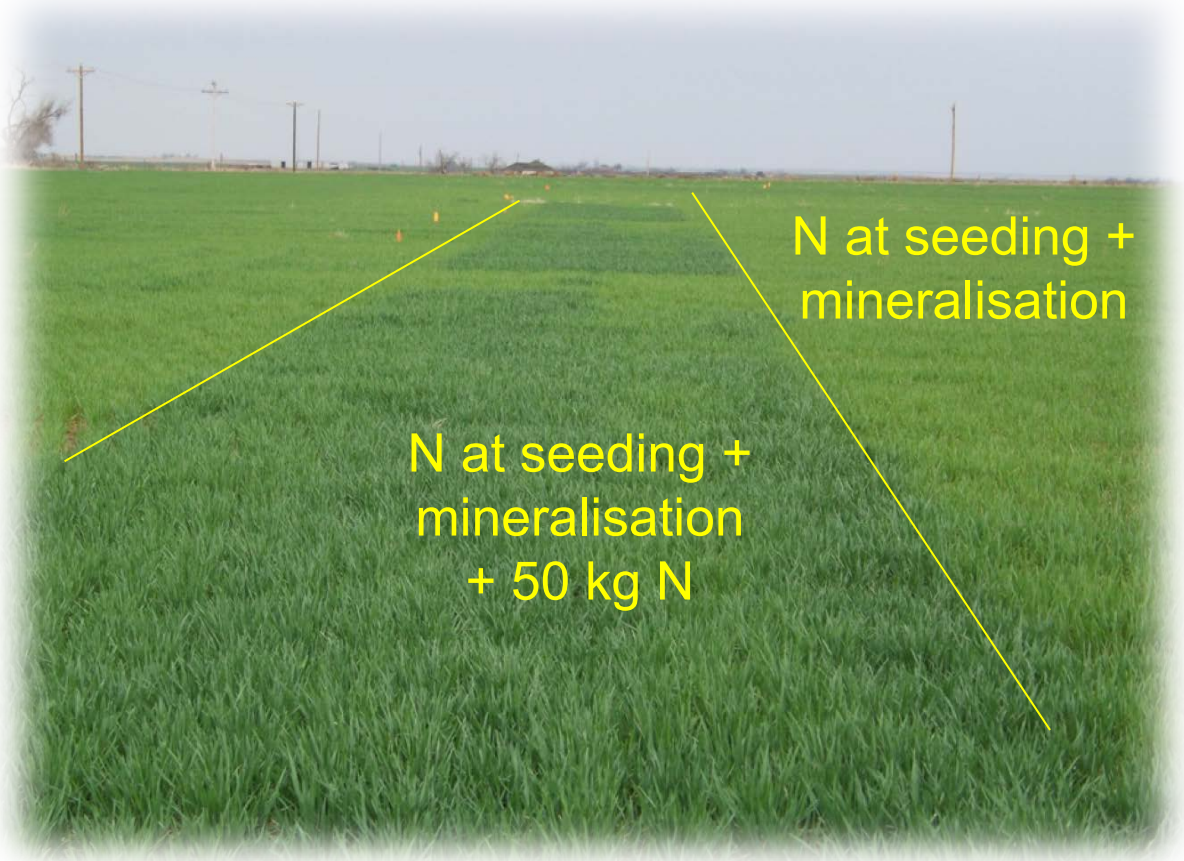
50 mm = 1 t/ha

1 t/ha = 40 kg N/ha (50% NUE)

50 kg urea per inch of rain!

Read the crop….

N-Rich strips



"The strips give me the confidence 'Not to apply N' when the crop is N sufficient. This has saved me a lot of $$$ over the years."
– Mark Branson, grain grower, South Australia.

- Potential response to 50 kg N extra
- May not want to *realise* this potential.

Stubbles and N - from 2016 to now….

Stubble from a 7 t crop

Burn - Loose 45 kg N/ha

Bale - Loose 55 kg N/ha

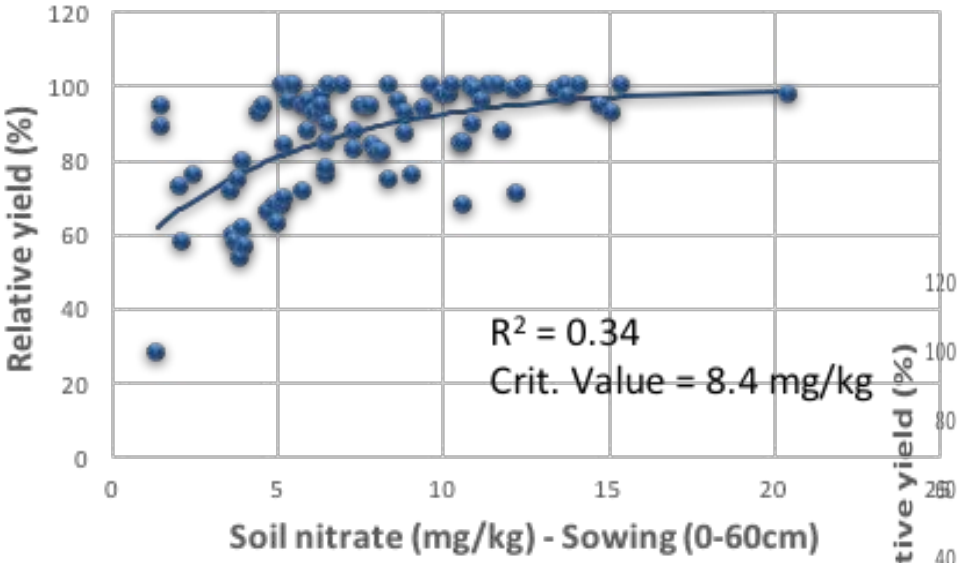
Mulch - Loose 42 kg N/ha
(immobilisation)

- N from legume residues to the next cereal crop: 25-35%
- N from cereal residues to the next cereal crop:

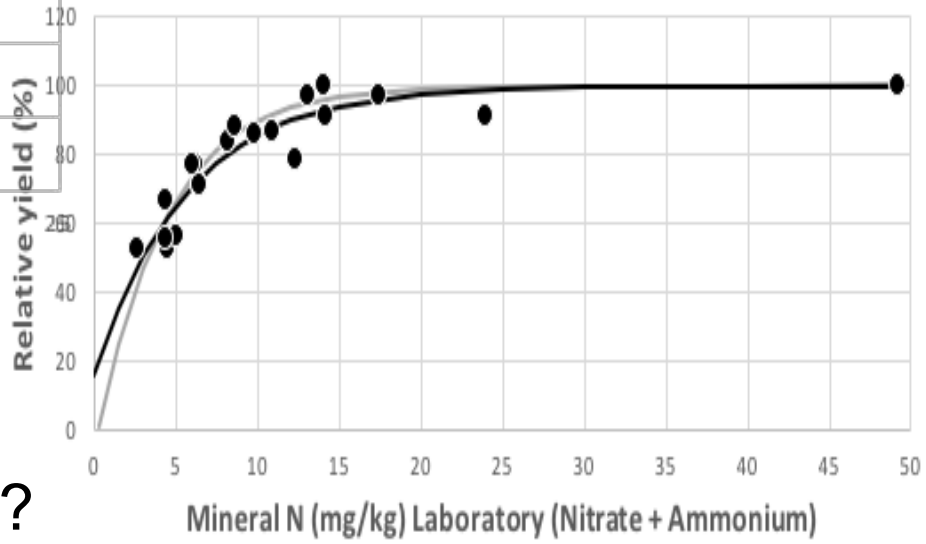
Location	Treatment	N in Stubble (kg N/ha)	N in next crop (% stubble N)
Karoonda	Surface	12	2.1
	Incorp		3.1
Temora	Surface	55	8.7
	Incorp		15.4
Horsham	Surface	32	4.4
	Incorp		5.0

Gupta, McBeath, Richardson, Kirkegaard, Sanderman (CSIRO unpublished)

In-crop mineralisation – important?



Mason et al. EPFS 2016

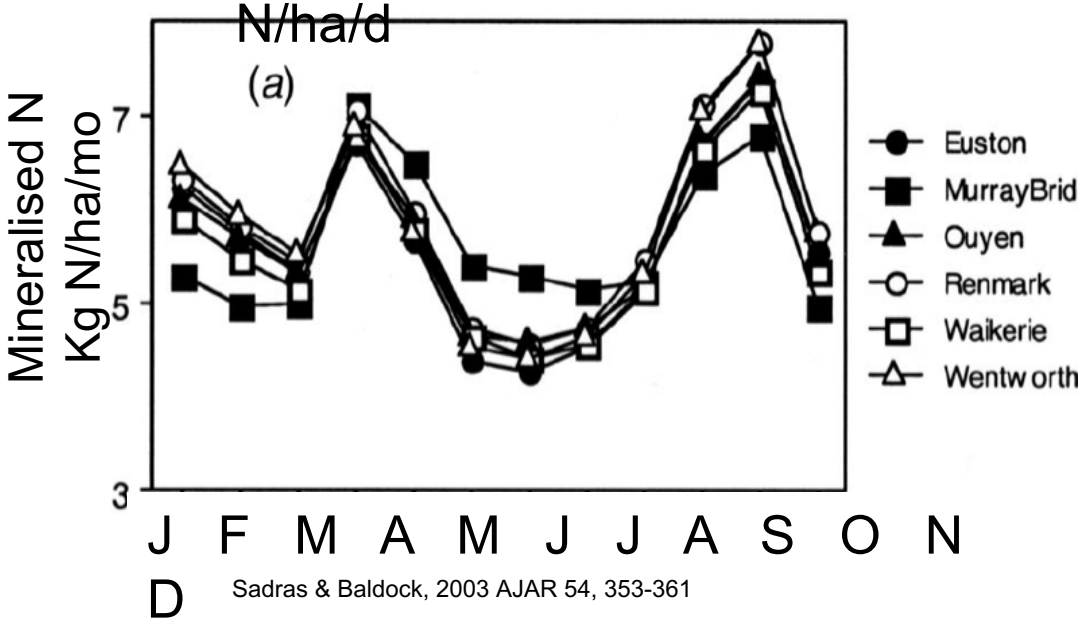


12 mg/kg critical value
94 kg N/ha

- How to do, what to include?
  - Nitrate + Ammonium
  - In-row a little better than between row.
  - Laboratory best – some in-field testing promising.

Mineralisation – the pattern

Total N ~ 60 kg N/ha
Winter ~ 0.1 kg N/ha/d
Autumn/Spring ~ 0.2 kg N/ha/d



Sadras & Baldock, 2003 AJAR 54, 353-361

Total Soil N -
Temps >5°C
SWC <80% (0-10 cm)

Summer mineralisation

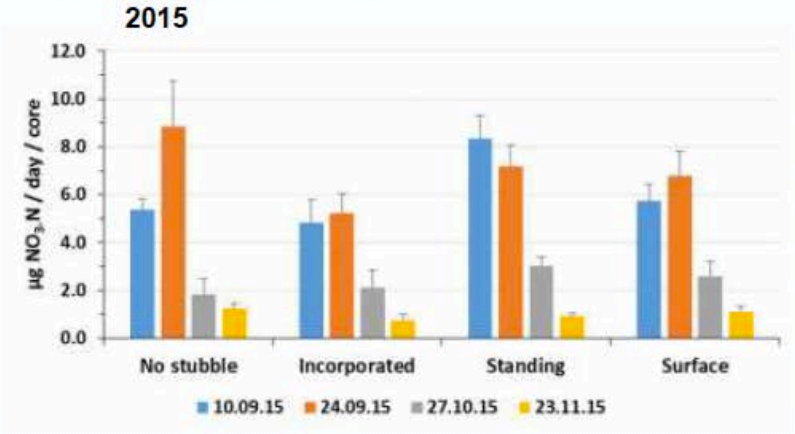
- 0.5 kg N/ha/mm/%OC over summer following legume
- 0.3 kg N/ha/mm/%OC over summer following cereal

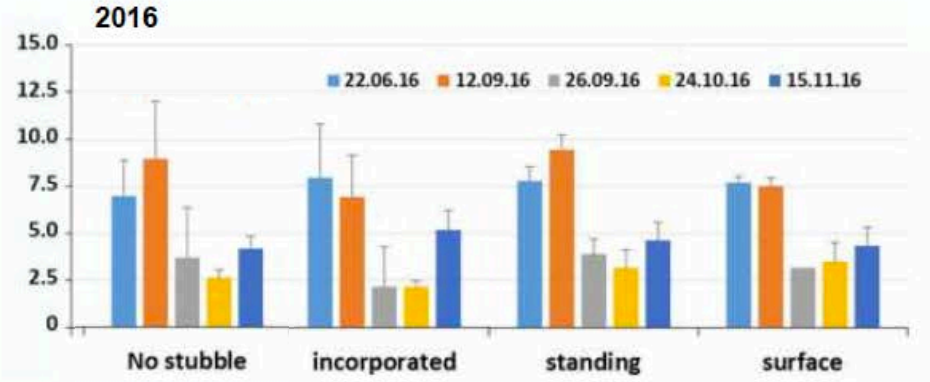
”expect”
20-40 kg N/ha to come

For Wimmera/Mallee OC*Seasonal/6 is OK for whole season
(r^2=0.75 for cereal/legume rotations Dunsford et al. 2015, Agronomy Conference Tasmania)

In-situ N mineralization during crop season (Karoonda 2015 & 16) (Wheat after Wheat)

Resin strip in Raison tubes



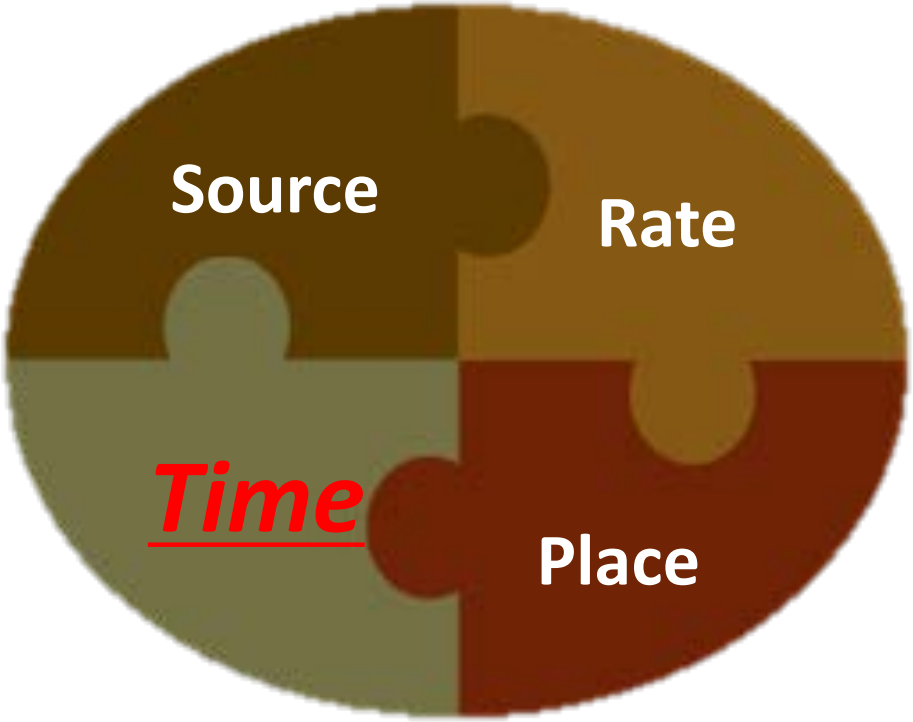


- Seasonal conditions effects on microbial turnover major factor

Gupta V.V.S.R. et al. CSIRO Unpublished

N is – *again* – the big ticket item.

- 4R nutrient stewardship – select the RIGHT source, apply it at the RIGHT rate, at the RIGHT time and in the RIGHT place.



- **How late is too late? Crop + Weather + Budget**

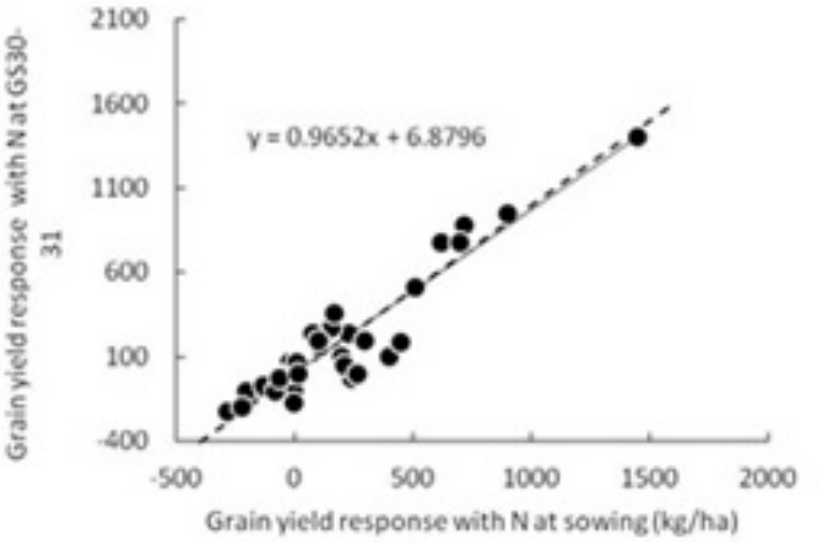
Crop and timing responses to N

Responses		N applied at:				
	Nil N	DC31	DC42	DC65	DC72	LSD p>0.05
Yield (t/ha)	3.31	3.94	3.23	3.29	3.14	0.31
Protein (%)	8.6	9.4	10.4	9.8	8.9	0.4
N recovered (kg N/ha)	50	65	59	57	49	
% Recovery		75%	44%	33%	-4%	

20 kg N/ha applied at various times (Yitpi)

- Rate and timing interact (efficiency)
- Earlier N = Yield
- Later N = Protein

Penalty to delaying N?

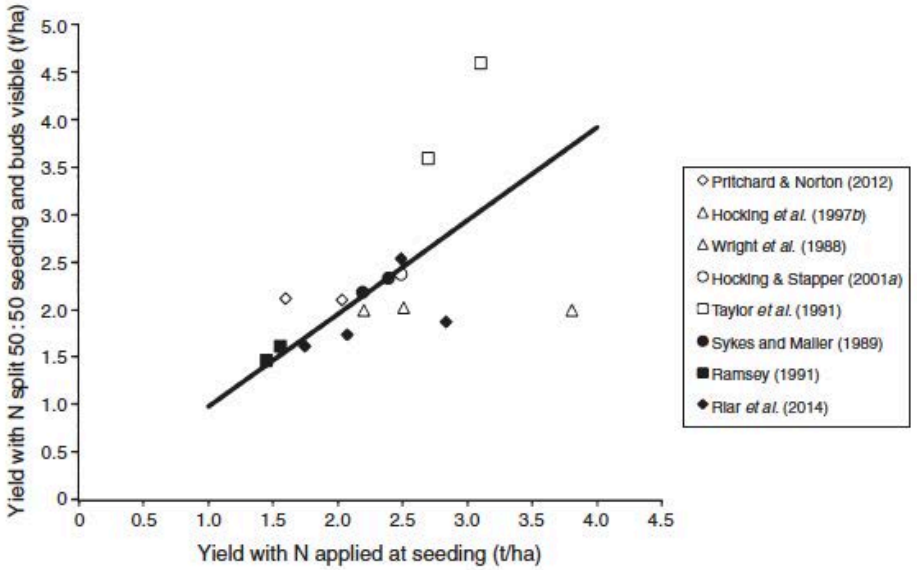


Loss processes operating

Leaching

Denitrification

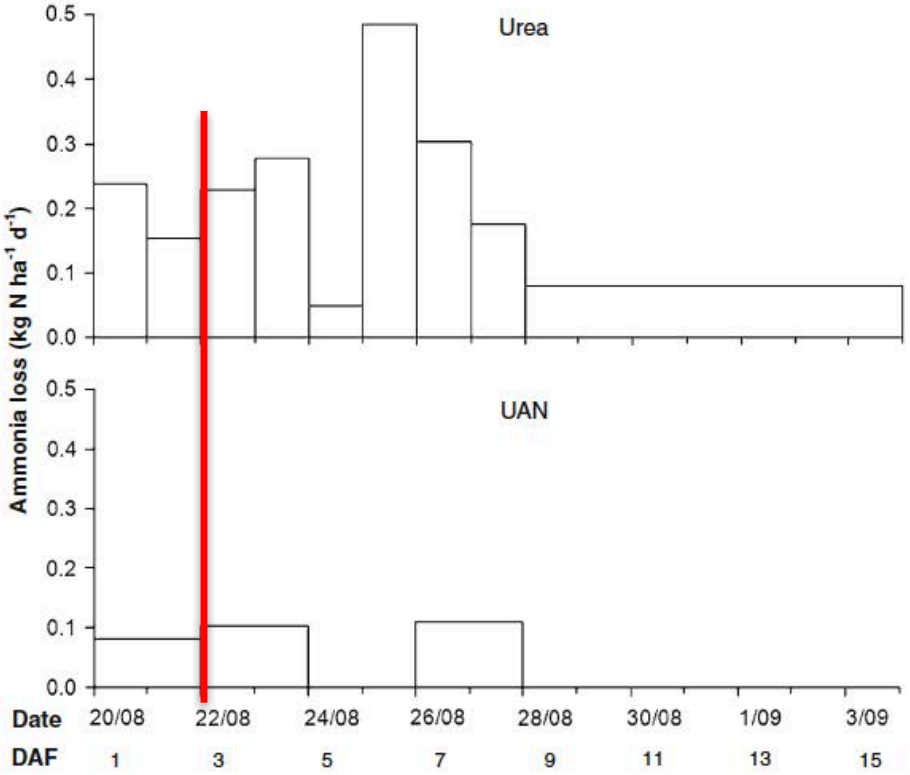
Late rains



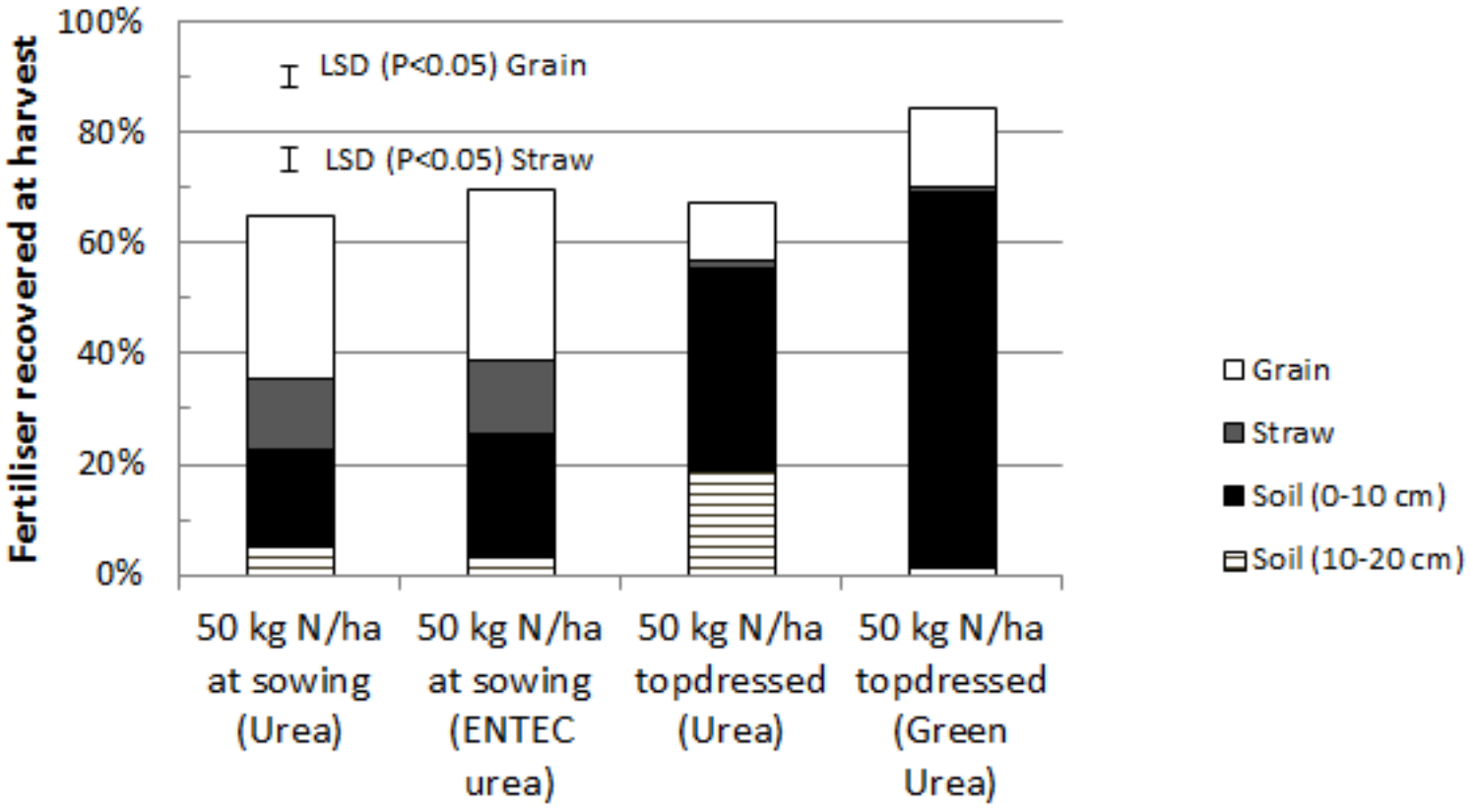
Timing relative to rain & situation

Turner et al. 2012 (Nutrient Cycling in Agroecosystems, 93, 113-126)

- 1 expt in Mallee
  - 5.4% N loss from urea
  - 2% loss from UAN
  - *4 mm rain 2 DAF*



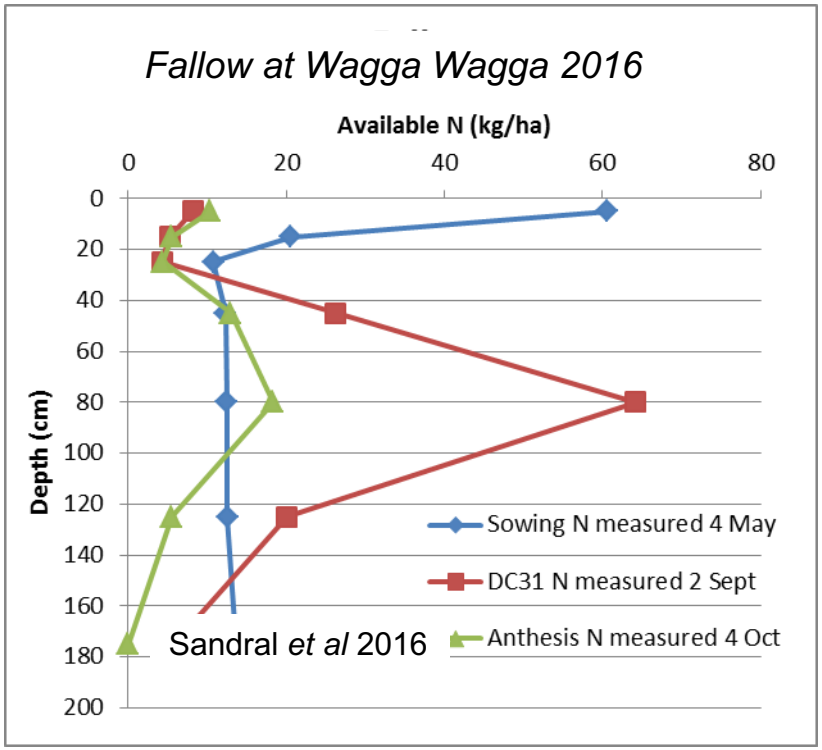
What happens if it does not rain at all?



Ash Wallace & Roger Armstrong; Horsham, 2014 – a dry year - 1.5 – 2.2 t/ha
Losses in wetter years?

What happens if it gets *REAL* wet?

NSW GOVERNMENT Department of Primary Industries



May 4th	Sept 2nd	Oct 4th
18 NH_4^+	13 NH_4^+	30 NH_4^+
124 NO_3^-	121 NO_3^-	25 NO_3^-
142 Total N	134 Total N	55 Total N

- Total loss = 87 kg N/ha over 32 days!
- More ammonium than nitrate unusual!

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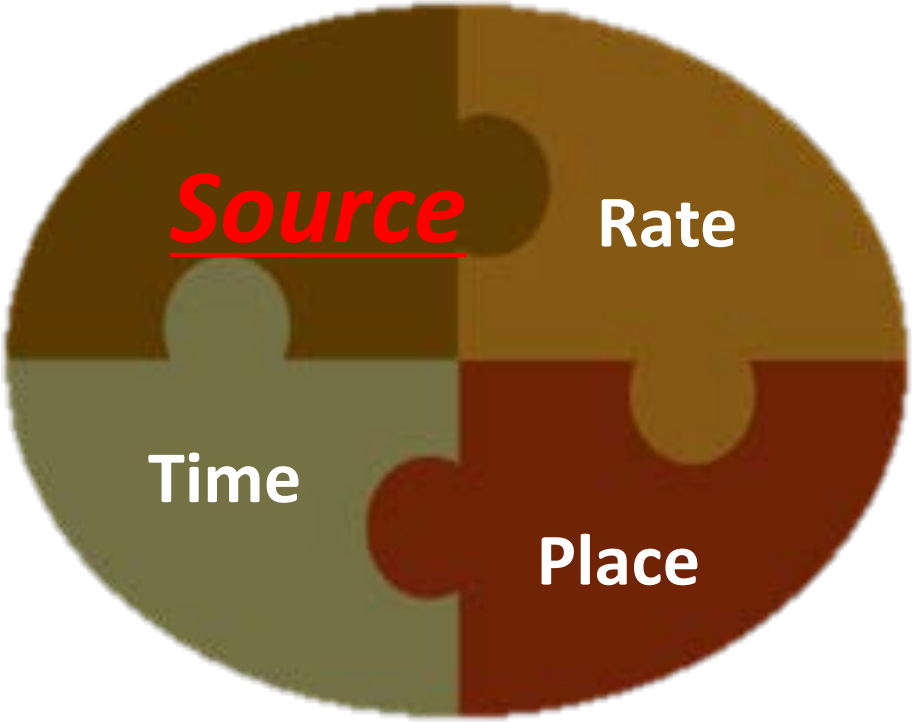

- **Is there anything between the different N sources?**

N source – foliar, soil or what??

- N is taken up through the leaves
- Limited by either urea toxicity, salt burn or leaf area.

- The amount taken up through leaves is probably 10-15 kg N/ha
- Timing is important
- Worst effect if flag leaf is damaged
- Rest is taken up through roots.

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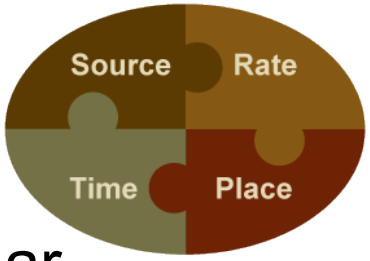
Source Comparisons



- Little agronomic difference between fluid/granular

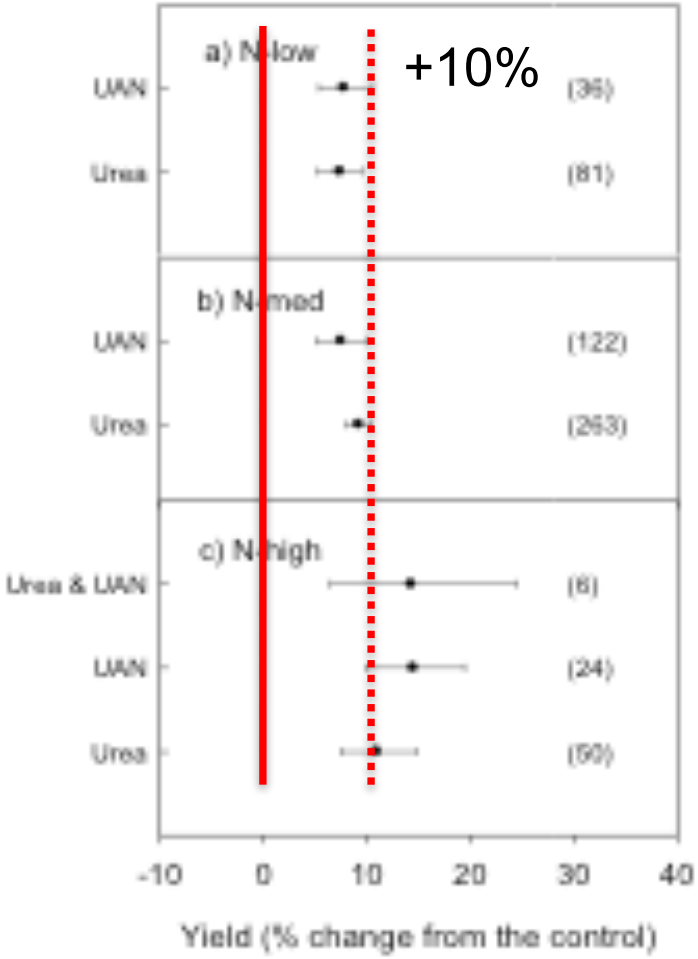


Fig. 1: The effect of different N sources (urea or UAN) on grain yield (a) and N uptake (b).

Selection of source maybe more on logistics than just efficiency.

- Ease of handling
- Quantities applied
- Product quality
- Application
- Carryover

S Cameron, Twitter

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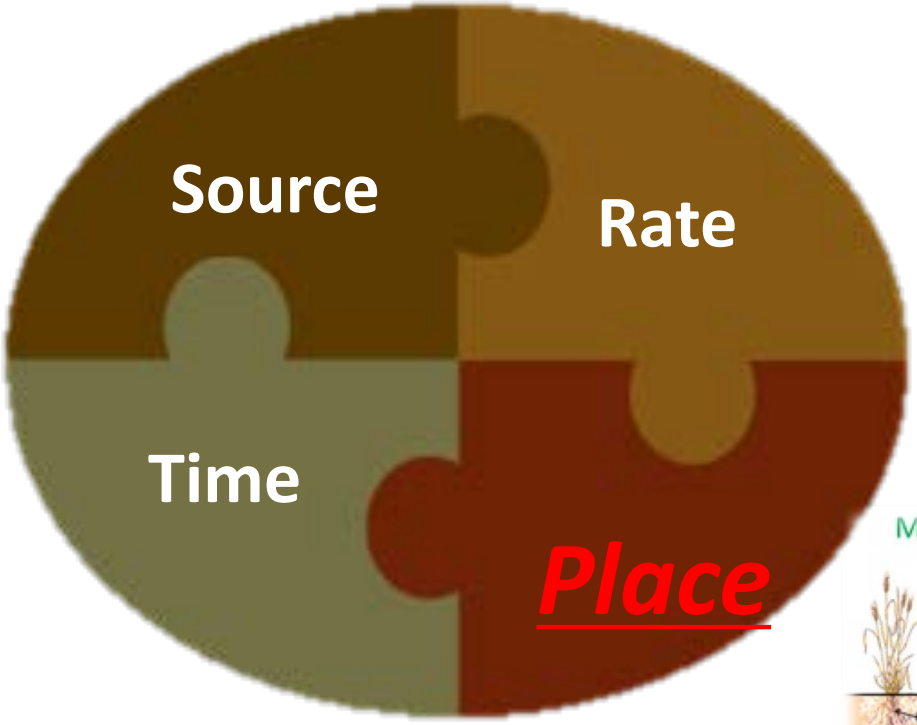

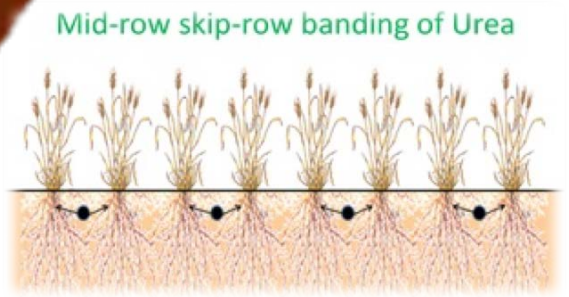

- **Foliar & soil – interaction with source.**
  - **In-crop mid-row banding**

Mid-row banding urea in-season 2016

Ash Wallace, DEDJTR, Horsham

- Comparing:
  - Banding above and below surface
  - Streaming nozzles
  - Conventional nozzles
  - Topdressed granular

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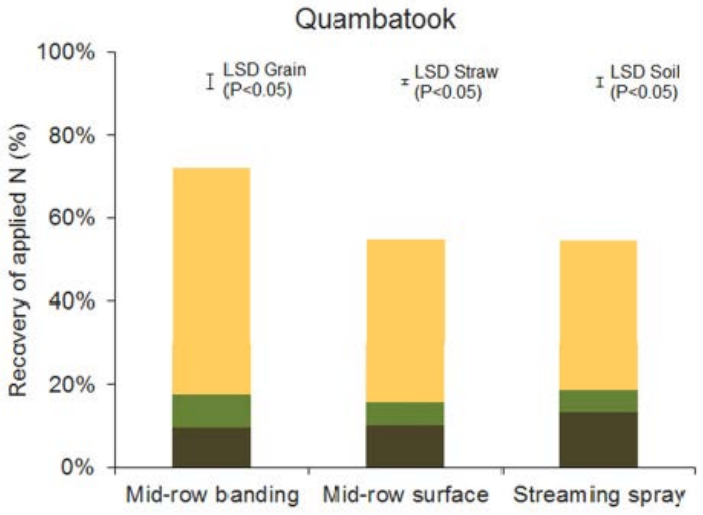
Mid-row banding urea in-season 2016

- Protein response to MRB at Quambatook
- Yield (+0.5 t/ha) response at Longerenong
- Responses varied with site, time of application and follow-up conditions.
  - 'Why?' is the key
- Higher plant uptake from mid-row banding (15N studies)
  - 60-75% of fertiliser 'taken up' vs. 40-65%
- Already commercial in Canada (corn) and some local growers

Quambatook
(50 kg N/ha only)

Application method	Yield (t/ha)	Protein (%)
Mid-row banded	4.08	7.8[a]
Mid-row surface	3.75	7.5[ab]
Broadcast granular	3.68	7.7[a]
Streaming spray	3.84	7.3[b]



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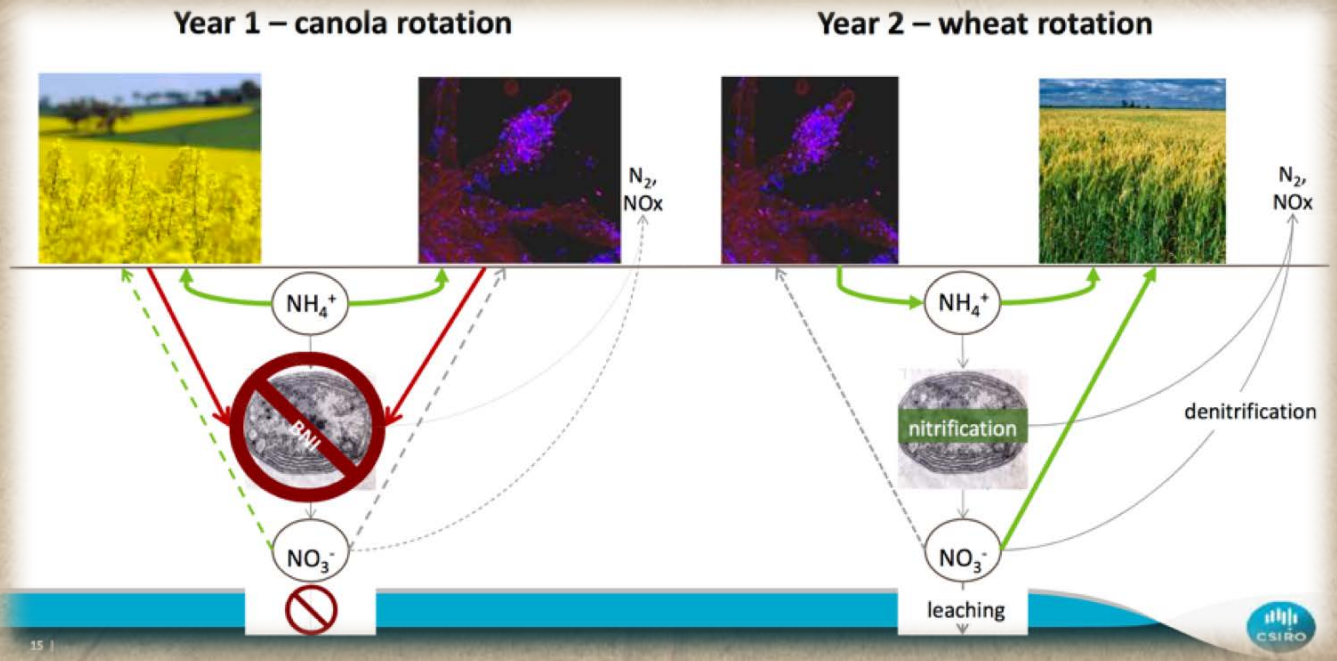
Application

Accu-Spread®

Mixing compatibility with fluids

So what's going on here…….2015

- Lodging, small grain in patches
- Haying off in the areas adjacent to the tracks
- Poor spreader patterns – excess N near the tracks.
- Worse in the canola –higher N status



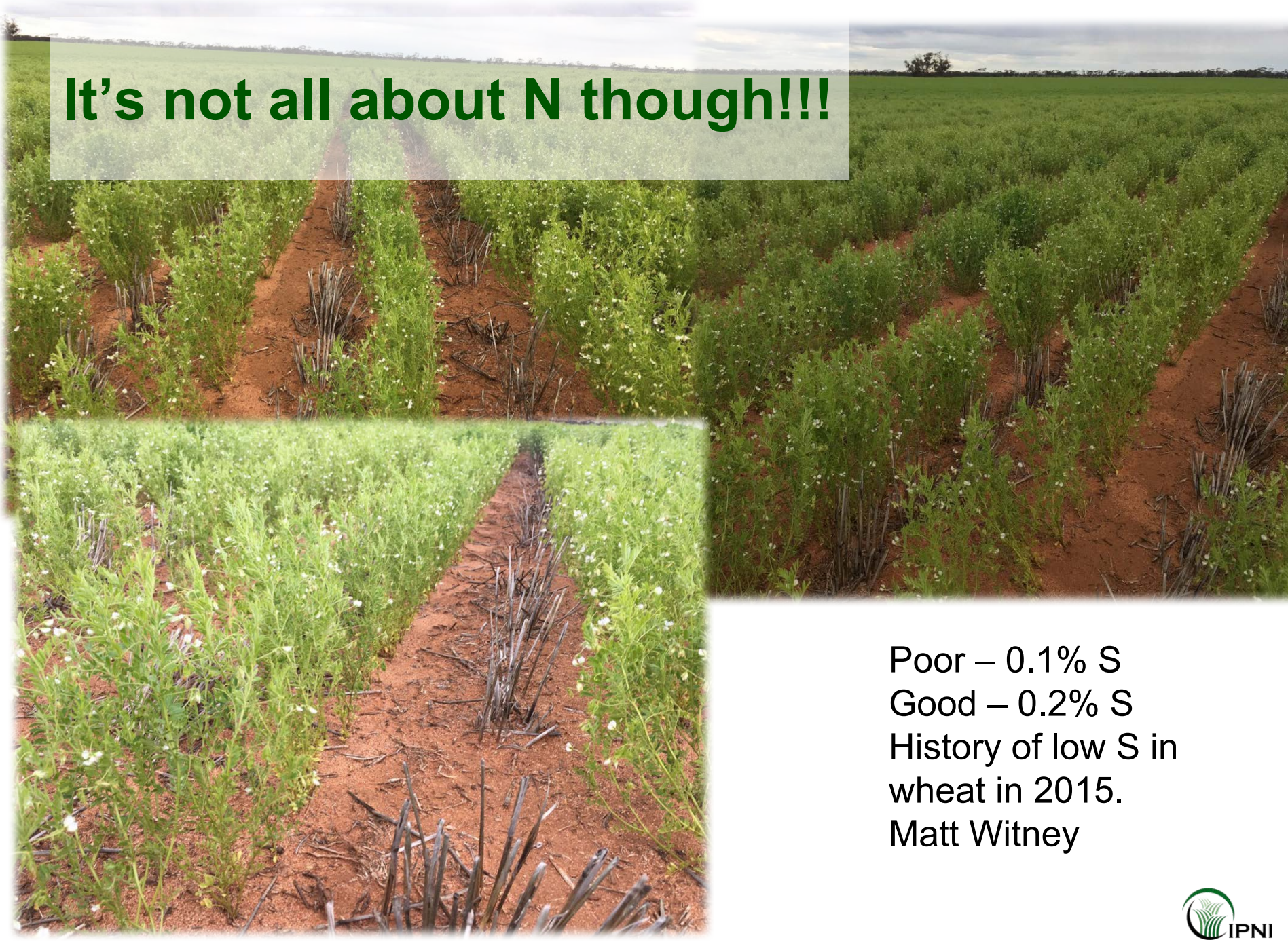
Rhizosphere nitrification inhibition by canola roots. *Catherine O'Sullivan et al. 2016*

Yes / No / Wait
Sorry?

Criteria for making N decisions

- Is N short?
- Can you get it / afford it?
- Timing – crop
- Timing – weather
- Seasonal forecast.

It’s not all about N though!!!

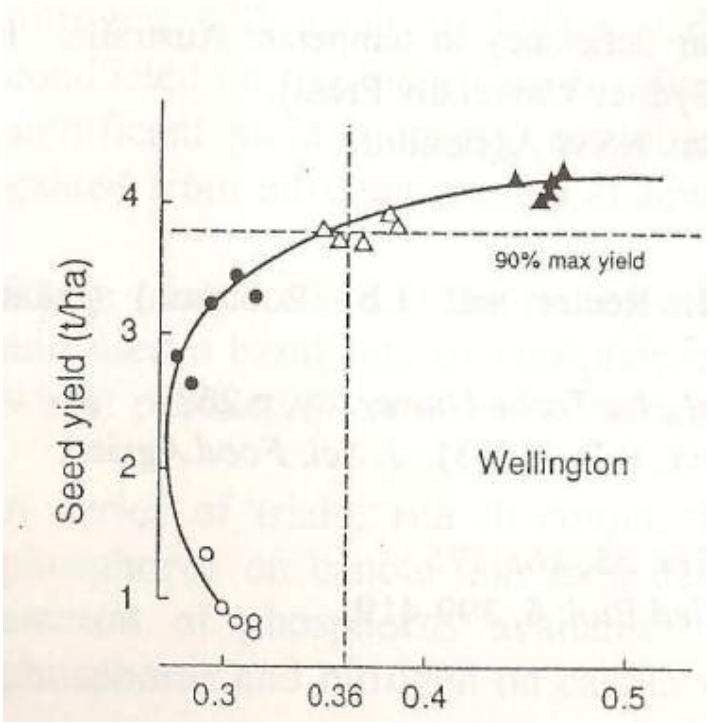


Poor – 0.1% S
Good – 0.2% S
History of low S in wheat in 2015.
Matt Witney

S deficiency symptoms

Tissue Tests for Diagnosing S deficiency

- *eg* Canola - 0.36% S in whole shoots at start of flowering

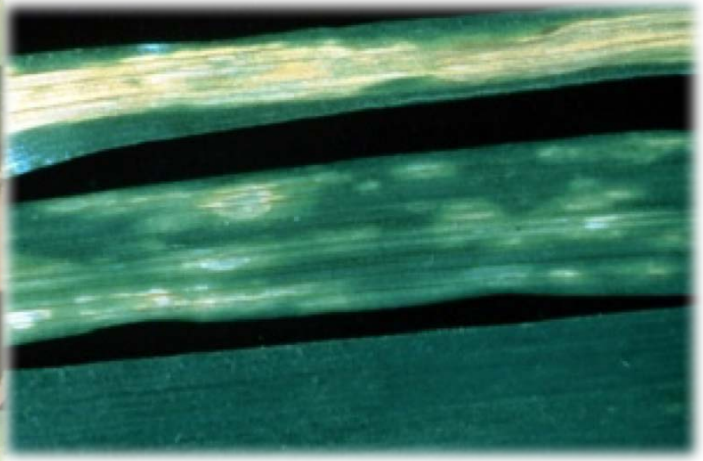


Wheat	YEB Critical	Cotton	YML %S
FS 4-5	0.28%	Flow'ing	<0.2%
FS 5-6	0.32%		

Critical S values lower in N deficient plants
Reuter & Robinson 1997

- Highly dependant on GS/tissue.
- Need rapid tests
- Root penetration when sampled
- Grain analyses for retrospective diagnosis

Pinkerton A. PJ Hocking, A Good, J Sykes,s RBD Lefroy, GJ Blair. (1993) A preliminary assessment of plant analysis for diagnosing S deficiency in canola. Proceedings of 9th Australian Research Assembly on Brassicas, Wagga Wagga, p21-28.



	Cu	Fe	Mn	Zn	B	Mo
pH > 7.0	---	---	--	---	**	++
pH < 5.5	++	+++	+++	+	--	--
water-logged soil	+	--	+	+		
drought	---	---	---	-	---	--
high humus content	---	++	++	++	++	-
high P-content	-	---	-	---	-	+++
sand	---	---	--	---	--	-
compaction	+	++	+	+	+	+

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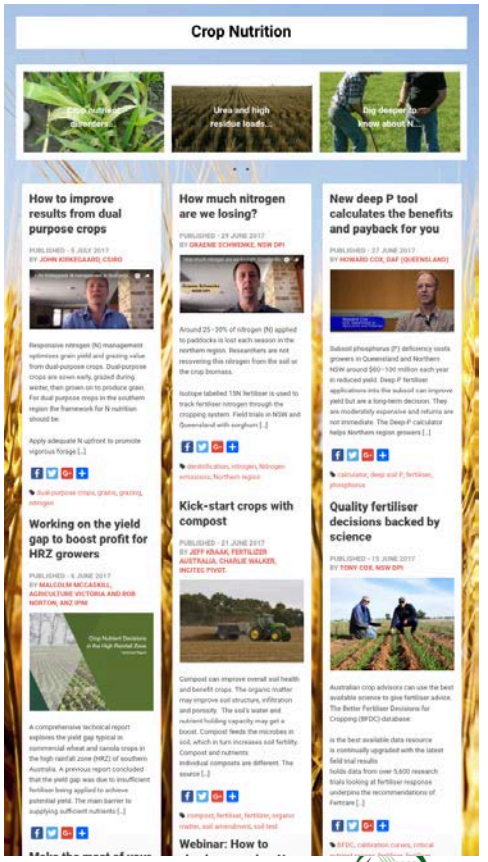
Summary points

- Silk purses cannot be made from sow's ears.
- N, S, B and maybe K may be deeper into the profile and access to these may be delayed or reduced.
- Set N supply to meet yield potential – which looks reasonable given that subsoil moisture levels are good. Still a long way to go though so make N decisions in the light of that yield potential.
- Getting the right nutrient source at the right rate, right time and right place is the basis of good nutrient management.
- It's not all about N – keep an eye on S and Zn especially in the Mallee. Tissue tests problems.
- Keep in contact – Twitter @IPNIANZ
  - http://extensionaus.com.au/crop-nutrition/



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