IPNI
INTERNATIONAL
PLANT NUTRITION
INSTITUTE

Figure1. Wheat at tillering grown with 0 (left) and 100 kg/ha K.

Do we need to revisit potassium?
or
Is K OK?

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http://anz.ipni.net

Better Crops, Better Environment … through Science

GRDC
Grains
Research &
Development
Corporation

Adelaide, 26 February 2014.

South Australian Soil K test stats:

ex-K (mg/kg)	% South Australia	% Australia
<40	0	0.02
40-80	2	1
80-120	5	9
120-200	12	26
200-400	42	41
>400	39	24

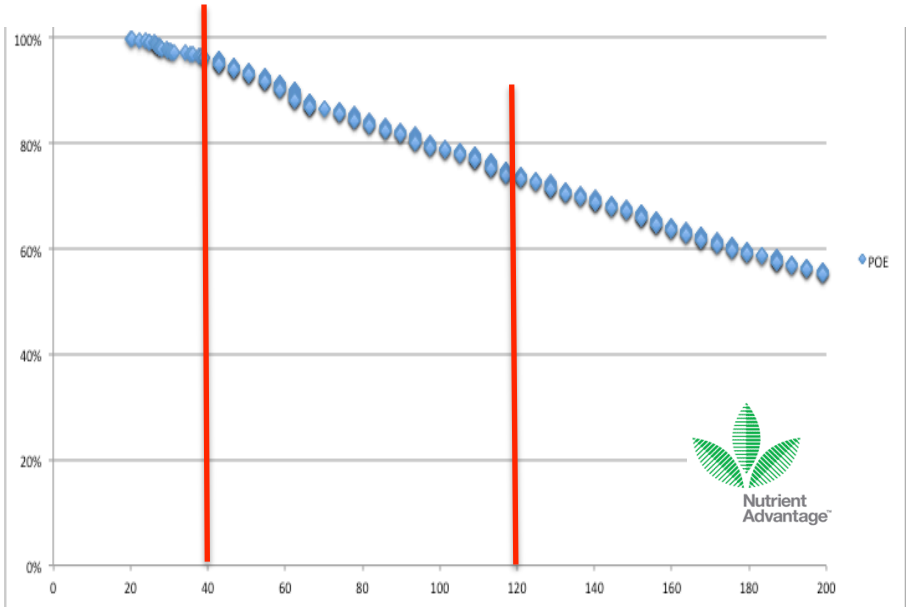
ANRA Audit 2001.

2012 Soil Test data

- ~7% <40 mg/kg
- ~25% <120 mg/kg

- Increase in frequency of low tests

Probability of exceedance for Colwell K (SA only)



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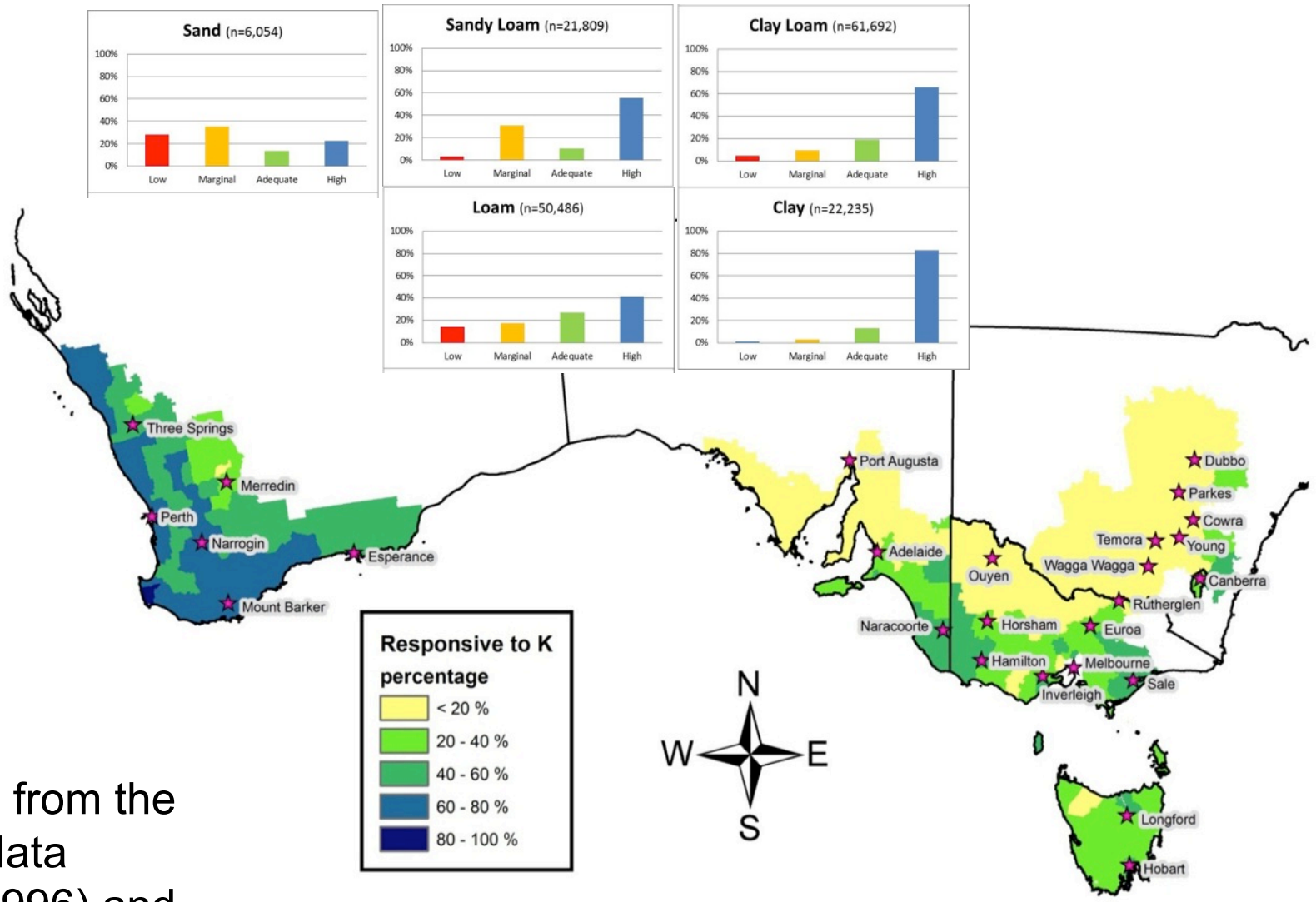
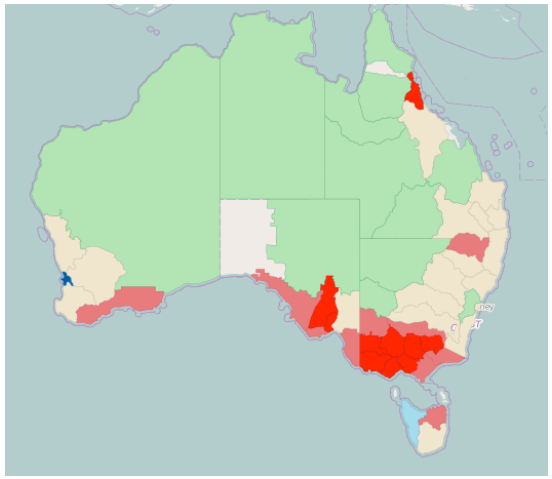
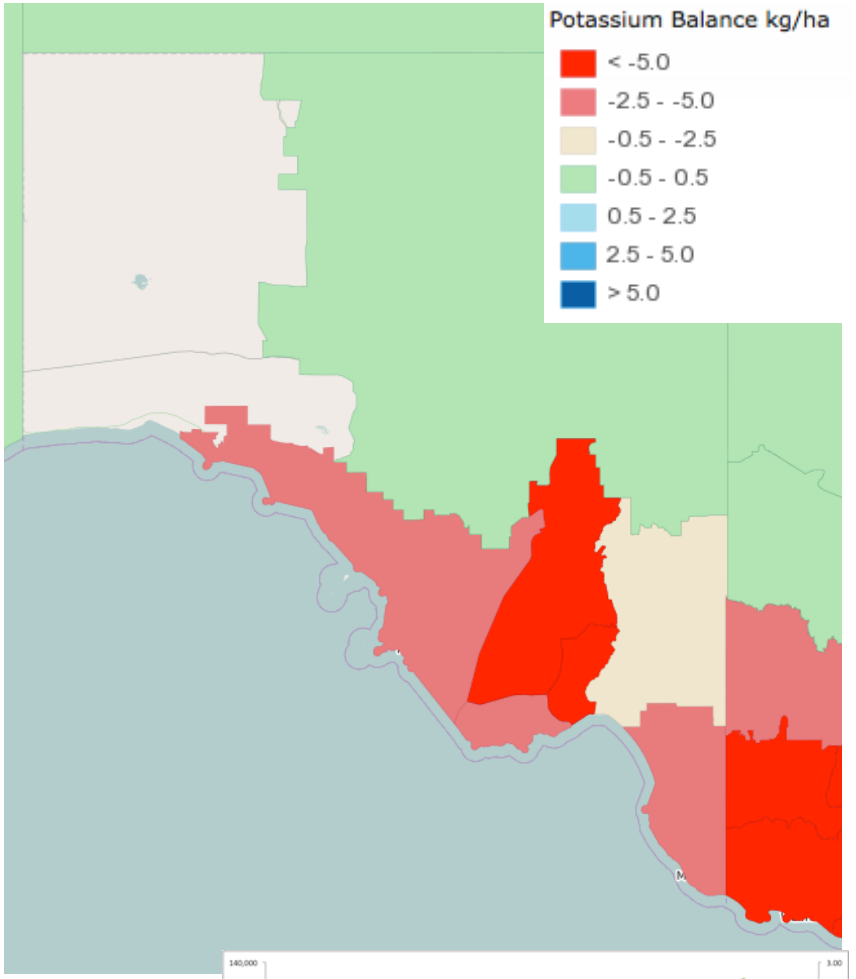


Derived from the ANRA data (1994-1996) and soil test values by region.

Source, B Christy, VicDEPI

Regional K balances



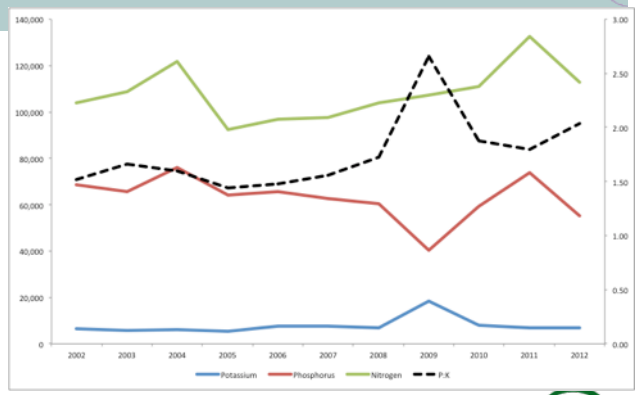


Nutrient balances

- K input (fertilizer K, ~7kt of K)

less

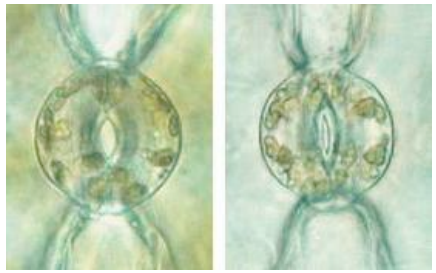
- K removal (products, mainly grain)
- http://maps.ubspatial.com.au/ozdsm/ozdsm_map.php



- **Continuing depletion of K reserves**

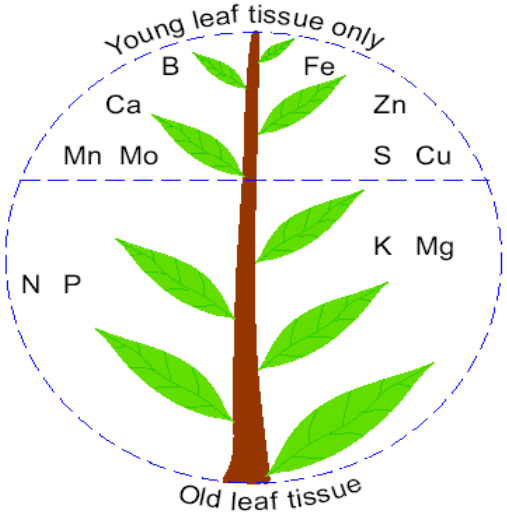
Potassium - K

- Is present in the plant essentially as the cation K^+ - not formed into bioactive compounds.



- Essential role in controlling cell water content.
  - maintains solution concentrations of other compounds.
  - regulates water content to open/close stomata.

- Quite mobile – so remobilized



- Two uptake mechanisms
  - High affinity @ very low concentrations
  - Low affinity @ higher concentrations

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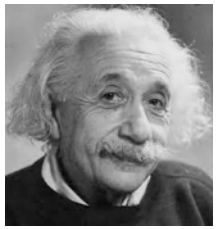
Wheat	**Sorghum**	**Soybean**
		
Chickpea	**Maize**	**Cotton**



If we knew what we were doing – it would not be called research would it?

K is one of the big 3 - NPK

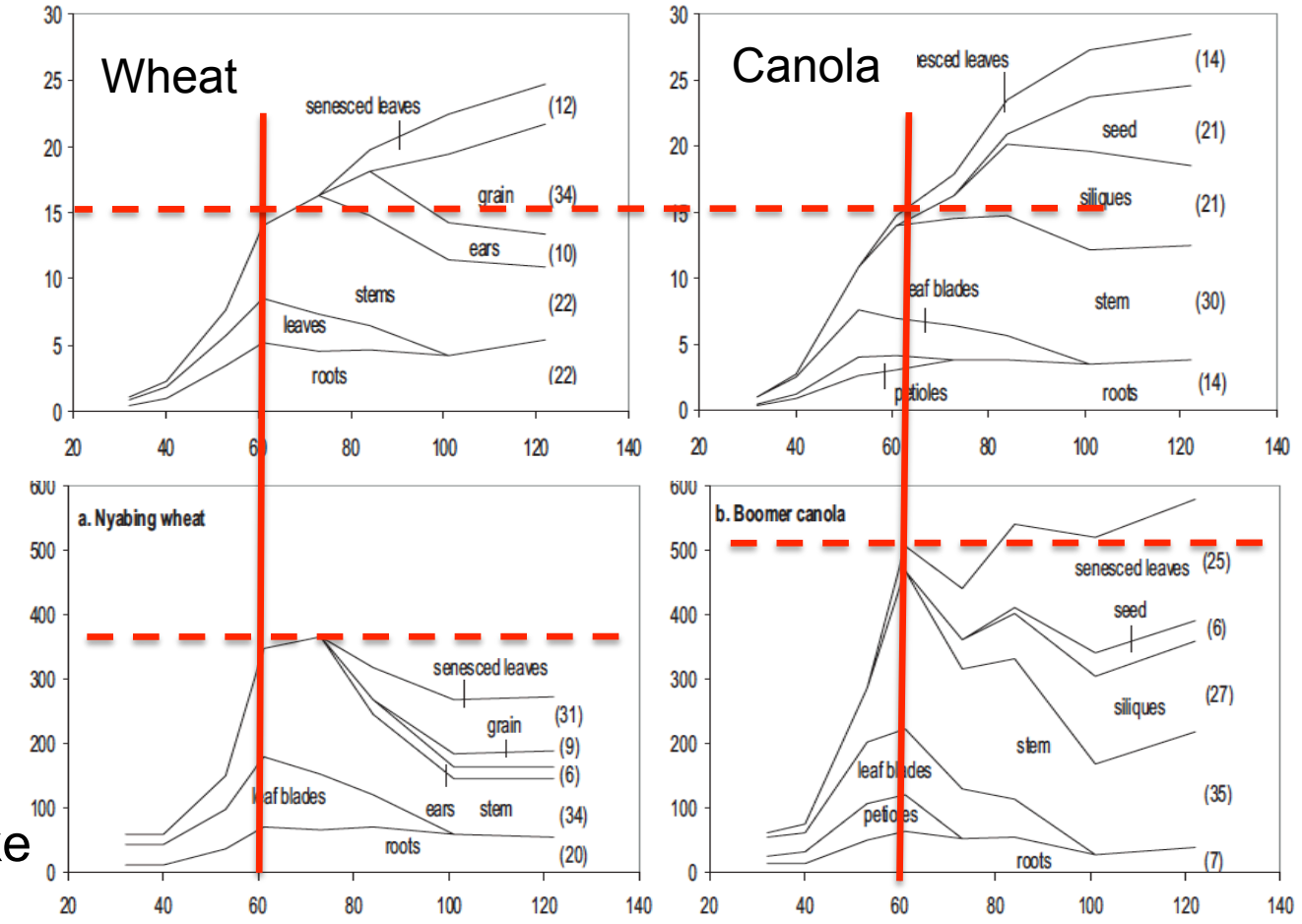
- **Macro**nutrient – it needs lots
  - Grain nutrient contents – kg nutrient/t

	N	P	K	S
Wheat Grain	17-23	2-4	4-6	1.5-3.0
Wheat Straw	4-6	0.5-1.0	10-14	1.0-2.0
Wheat Hay	*20*	*1*	*20*	*1.5*
Canola Grain	15-40	4-7	8-10	2-6
Canola Straw	4-10	2-4	25-31	3-12
Canola Hay	*30*	*3*	*35*	*8*

- But K demand and growth pattern vary.

Growth

K Uptake



At 60 DAS,

- wheat & canola have ~ 100% of K requirement.
- K demand by canola ~ 40% more than wheat
- Soil needs to supply K ~40% faster to canola

Early supply of K is important

Amount and rate of supply is important for K.

Rose et al. 2007,
J. Plant Nutr. Soil Sci.

K responsiveness by crop/activity

- Maize – v. high early
- Canola - high
- Chickpea/Lentil/Pea
- Wheat - moderate
- Lupin – low

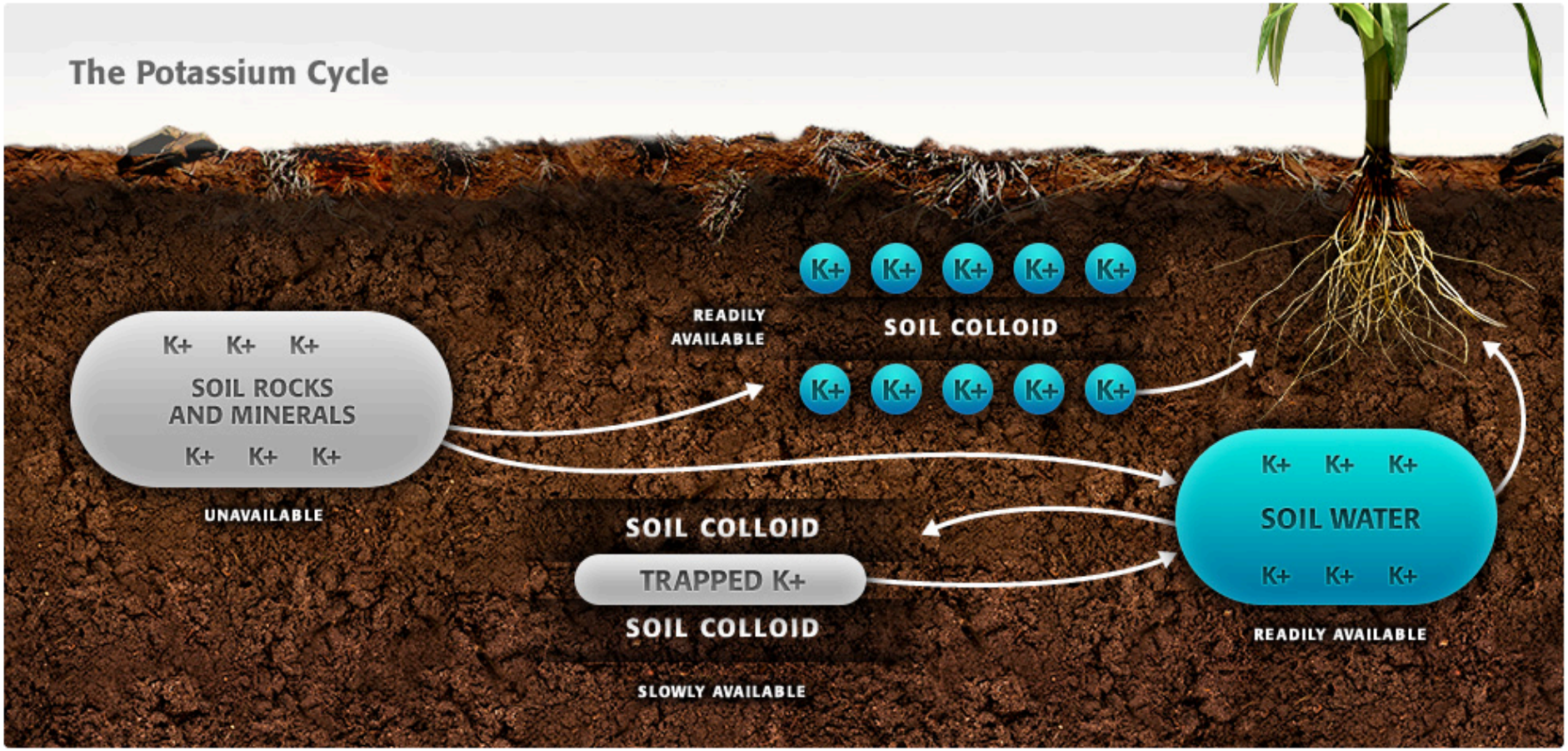
Grain – relatively low removal

Hay/Silage = very high

- Canola Hay – 35 kg/t
- Lucerne Hay – 24 kg/t
- Wheaten Hay – 20 kg/t
- Oaten Hay – 17 kg/t
- Oaten silage – 23 kg/t

Hay 90% DM, Silage 50% DM

K pools in soils



Structural K | Interlayer K | Exchangeable K | Solution K

Tetraphenyl Borate

Colwell K

Exchangeable K

*ex-K * 391 ~ Colwell K*

Texture effect – 0.21 exK = 100 CK (sand, exp 85)

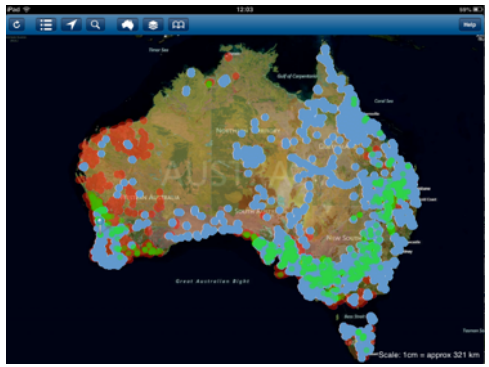
Critical Soil Test – Colwell K

- Pasture critical values 125 (sands) to 160 (clays) (BFD)
- BFDC interrogator – published values (WA data)
- In WA on sands, best calibrations for 0-30 cm
  - Yellow sands & Duplex – 29-35 mg/kg (wheat)
  - All soils – 37-41 (canola)

0-10 cm BFDC National	Wheat	Canola	Lupin
All Soils	41-49	43-47	22-28
Chromosols	35-45		
Ferrosols (Brown)	57-70		
Kandosols	45-52		
Tenosols	32-52	44-49	22-27
Tenosols 2-3 t/ha	37-48		
Tenosols >3t/ha	51-57		

(Brennan and Bell, 2013)

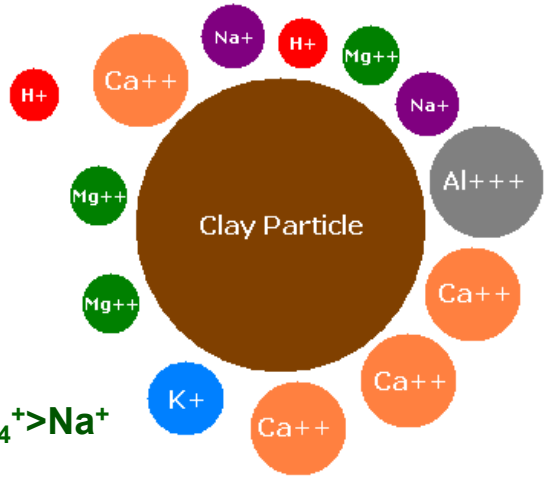
soil mapp



So – it is that easy?

SOIL SUPPLY SIDE

- Role of CEC & Clay type
- Role of Subsoil
- Role of pH
- Role of other cations (Mg/Na)



PLANT DEMAND SIDE

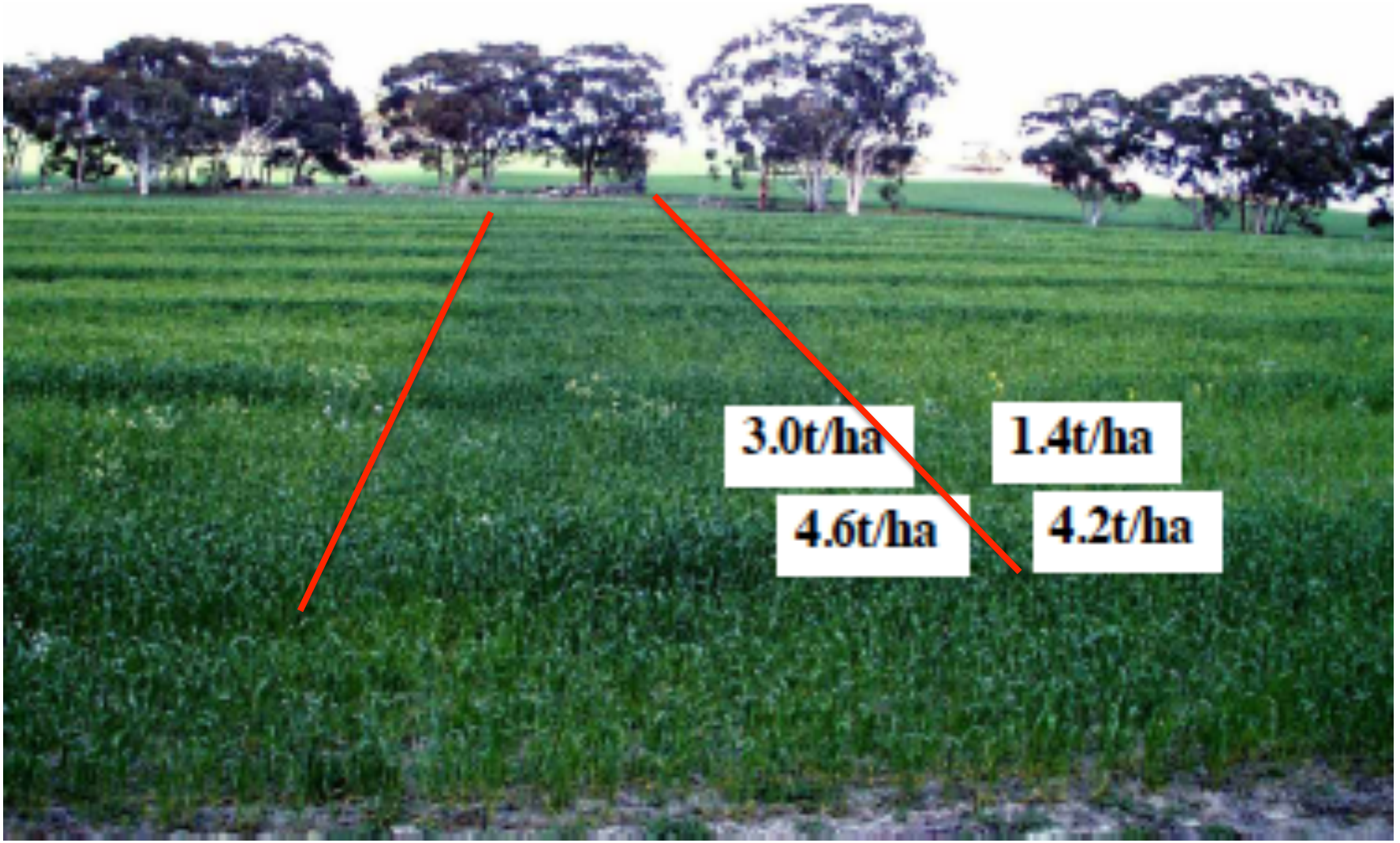
- Soil moisture & position
- Diffusion rate to root
- Rooting pattern (incl. row width).
- Na sub for K

$Al^{3+} > H^{+} > Ca^{2+} > Mg^{2+} > K^{+} = NH_4^{+} > Na^{+}$

Highest risk of K deficiency

- Sandy soils – low supply
- High rainfall – high demand
- Hay cutting – high removal

- Look for urine patches
- Look for windrow effects
  - N or K – symptoms/tissue test
- Try a K-rich strip/plot.
  - 50 kg K/ha at least presowing
  - Is K the limiting factor?



50 kg K/ha strip

IPNI Nutrient Source SPECIFICS

Potassium Chloride

No. 3

Potassium fertilizers are commonly used to overcome plant deficiencies. Where soils cannot supply the amount of K required by crops, it is necessary to supplement this essential plant nutrient. Potash is a general term used to describe a variety of K-containing fertilizers used in agriculture. Potassium chloride (KCl), the most commonly used source, is also frequently referred to as muriate of potash or MOP (muriate is the old name for any chloride-containing salt). Potassium is always present in minerals as a single-charged cation (K^+).

Production

85%

IPNI Nutrient Source SPECIFICS

Potassium Sulfate

No. 5

Potassium fertilizer is commonly added to improve the yield and quality of plants growing in soils that are lacking an adequate supply of this essential nutrient. Most fertilizer K comes from ancient salt deposits located throughout the world. The word "potash" is a general term that most frequently refers to potassium chloride (KCl), but it also applies to all other K-containing fertilizers, such as potassium sulfate (K_2SO_4, commonly referred to as sulfate of potash or SOP).

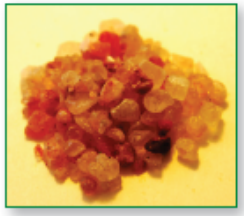
15%

IPNI Nutrient Source SPECIFICS

No. 6

Potassium Magnesium Sulfate: Langbeinite

Langbeinite is a unique source of plant nutrition since three essential nutrients are naturally combined into one mineral. It provides a readily available supply of K, Mg, and S to growing plants.



Underground mining operation

IPNI Nutrient Source SPECIFICS

No. 11

Potassium Nitrate

Potassium nitrate (KNO_3) is a soluble source of two major essential plant nutrients. It is commonly used as a fertilizer for high-value crops that benefit from nitrate (NO_3^-) nutrition and a source of potassium (K^+) free of chloride (Cl^-).

Production

Potassium nitrate fertilizer (sometimes referred to as nitrate of potash or NOP) is typically made by reacting potassium chloride (KCl) with a nitrate source. Depending on the objectives and available resources, the nitrate may come from sodium nitrate, nitric acid, or ammonium nitrate. The resulting KNO_3 is identical regardless of the manufacturing process. Potassium nitrate is commonly sold as a water-soluble, crystalline material primarily intended for dissolving and application with water or in a prilled form for soil application. Traditionally, this compound is known as saltpeter.

KNO_3 crystals & prills.

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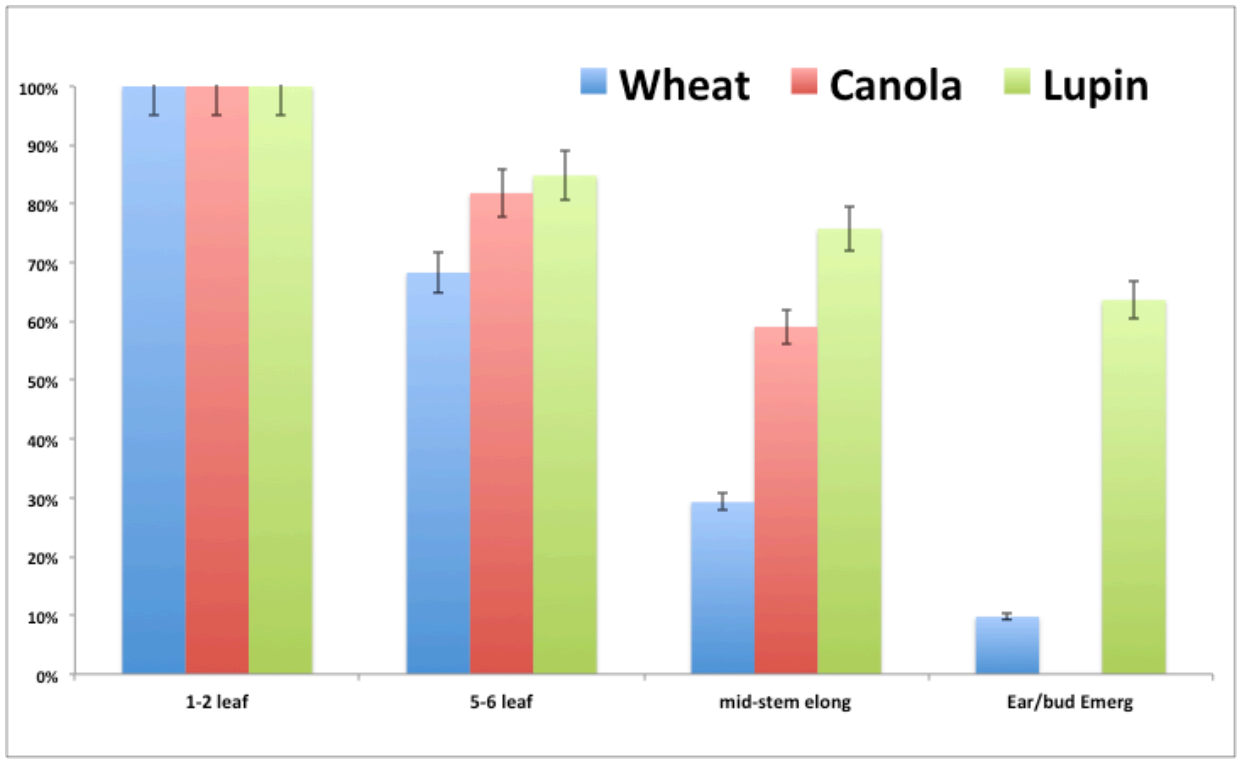
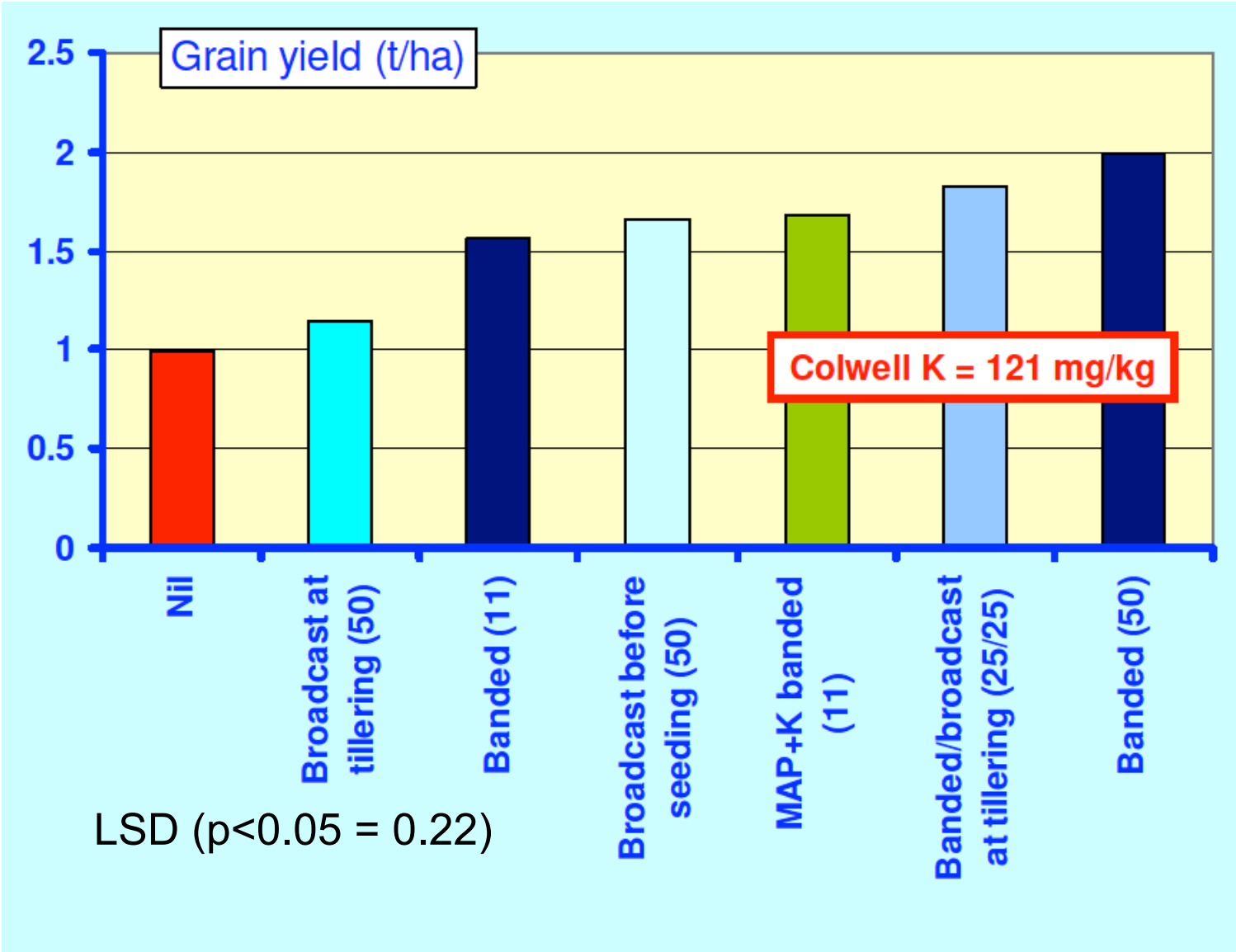
Response to timing of K



Brennan, 2013

- Care with rates >30 kg MOP/ha with seed (salt damage)
  - wheat more tolerant than canola.
  - row width, points, soil moisture, soil texture.
- http://seed-damage-calculator.herokuapp.com


Grain yield (t/ha)
2.5
2
1.5
1
0.5
0
Colwell K = 121 mg/kg
Nil
Broadcast at tillering (50)
Banded (11)
Broadcast before seeding (50)
MAP+K banded (11)
Banded/broadcast at tillering (25/25)
Banded (50)
LSD (p<0.05 = 0.22)

Summary

- Potassium is one of the essential macronutrients, along with N, P and S.
- Sandy, acid soils in high rainfall areas are most prone to K deficiency, particularly if cut for hay.
- Critical Colwell-K soil test ranges have been better defined for wheat, canola and lupins from the Better Fertilizer Decisions project.
- Sample depth, soil CEC, yield potential, soil water content, row width, presence of other cations and crop species all affect the critical soil test range.

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