



Potassium deficiency in local soils – what do we know?



Field Research

Field research evaluating new technologies, products and innovations >



Research

Independently evaluate new technologies, products and innovations. Delivering field research trials, glasshouse pot trials and on farm demonstrations. Our research service delivers flexibility, quality and integrity.



Education

Independent training in the area of soils and nutrition, maximizing production through education and extension of the latest innovations and technologies. Gain a sound understanding of soils and nutrition.

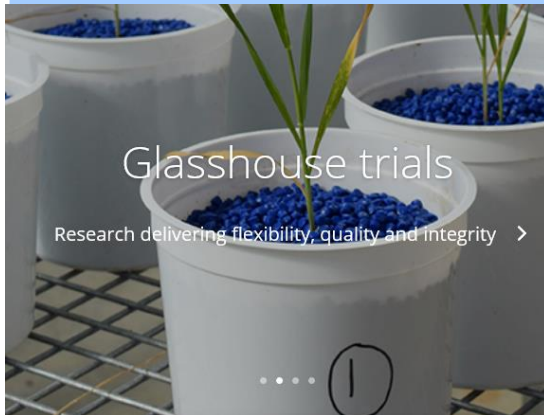
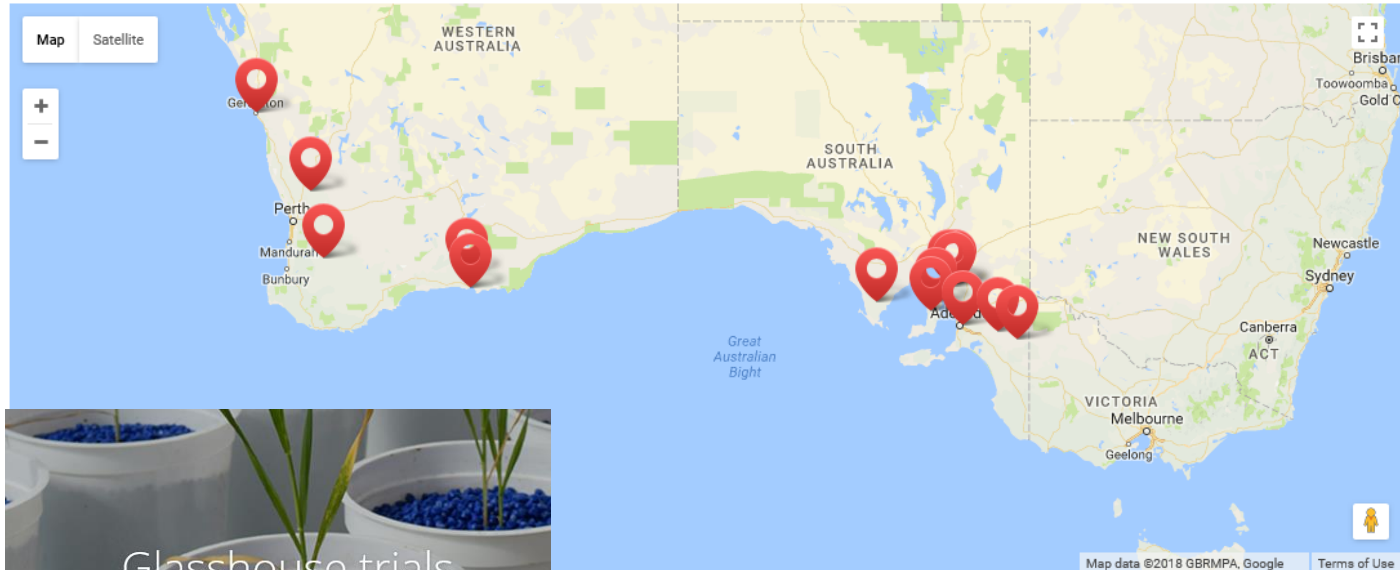


Advice

Providing advice to the agriculture industry. Soils and nutrition, farm nutritional plans, crop and farm monitoring programs

Field Research

Field research evaluating new technologies, products and innovations >



Potassium – plant deficiency symptoms



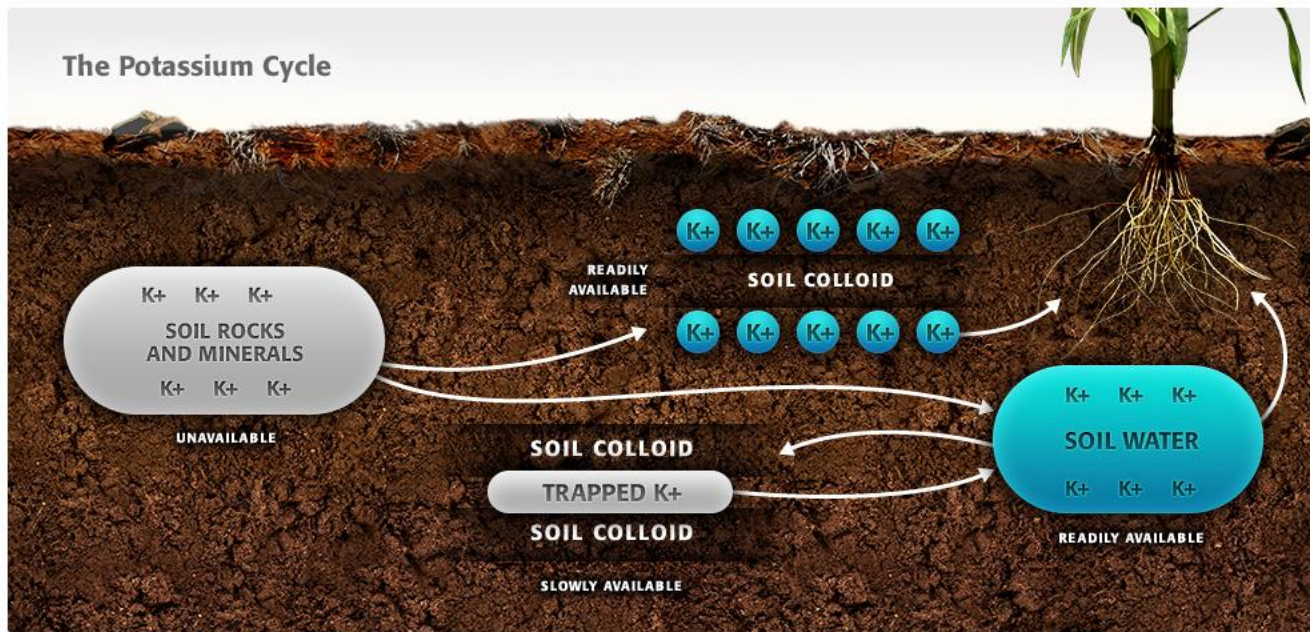
Potassium balance



| | 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 |

Potassium pools

Potassium supply to a crop



Structural K

Interlayer K

Exchangeable K

Solution K

Background to Eradu TRIAL

Industry feedback?

Do we have confidence in the soil test methods for K?

Providing valuable information on some soil types

Some soil types, questionable recommendations for the economic use of K fertilisers?

The importance of soil sampling procedures!!!

Colwell P-K



Current K lab methods WA

- Colwell K

Colwell P (1963) – 0.5M bicarbonate extract (@ pH 8.5) soil to solution ratio – 1:100, shaking time – 16 hours

| Years | Soil depth (cm) | Category | Wheat | Barley - feed | Barley | Oats-Hay | Oats-Grain | Canola |
|------------------|-----------------------|-----------------------|-------|---------------|--------|----------|------------|--------|
| All | 0-10cm | <i>R value</i> | 0.6 | | | | | 0.69 |
| | | <i>Critical value</i> | 69 | | | | | 47 |
| | | <i>Critical range</i> | 57-83 | | | | | 43-53 |
| All | 0-10 + 10-20cm | <i>R value</i> | 0.46 | | | | | 0.77 |
| | | <i>Critical value</i> | 45 | | | | | 39 |
| | | <i>Critical range</i> | 36-56 | | | | | 37-41 |
| 2000-2016 | 0-10cm | <i>R value</i> | 0.54 | | | | | 0.78 |
| | | <i>Critical value</i> | 52 | | | | | 52 |
| | | <i>Critical range</i> | 42-65 | | | | | 46-60 |
| 2000-2016 | 0-10 + 10-20cm | <i>R value</i> | 0.61 | | | | | 0.7 |
| | | <i>Critical value</i> | 39 | | | | | 41 |
| | | <i>Critical range</i> | 34-45 | | | | | 37-47 |
| WA - all | 0-10cm | <i>R value</i> | 0.48 | | | | | 0.69 |
| | | <i>Critical value</i> | 43 | | | | | 47 |
| | | <i>Critical range</i> | 37-49 | | | | | 43-53 |
| WA - all | 0-10 + 10-20cm | <i>R value</i> | 0.65 | | | | | 0.77 |
| | | <i>Critical value</i> | 37 | | | | | 39 |
| | | <i>Critical range</i> | 33-41 | | | | | 37-41 |

Current K lab methods EAST

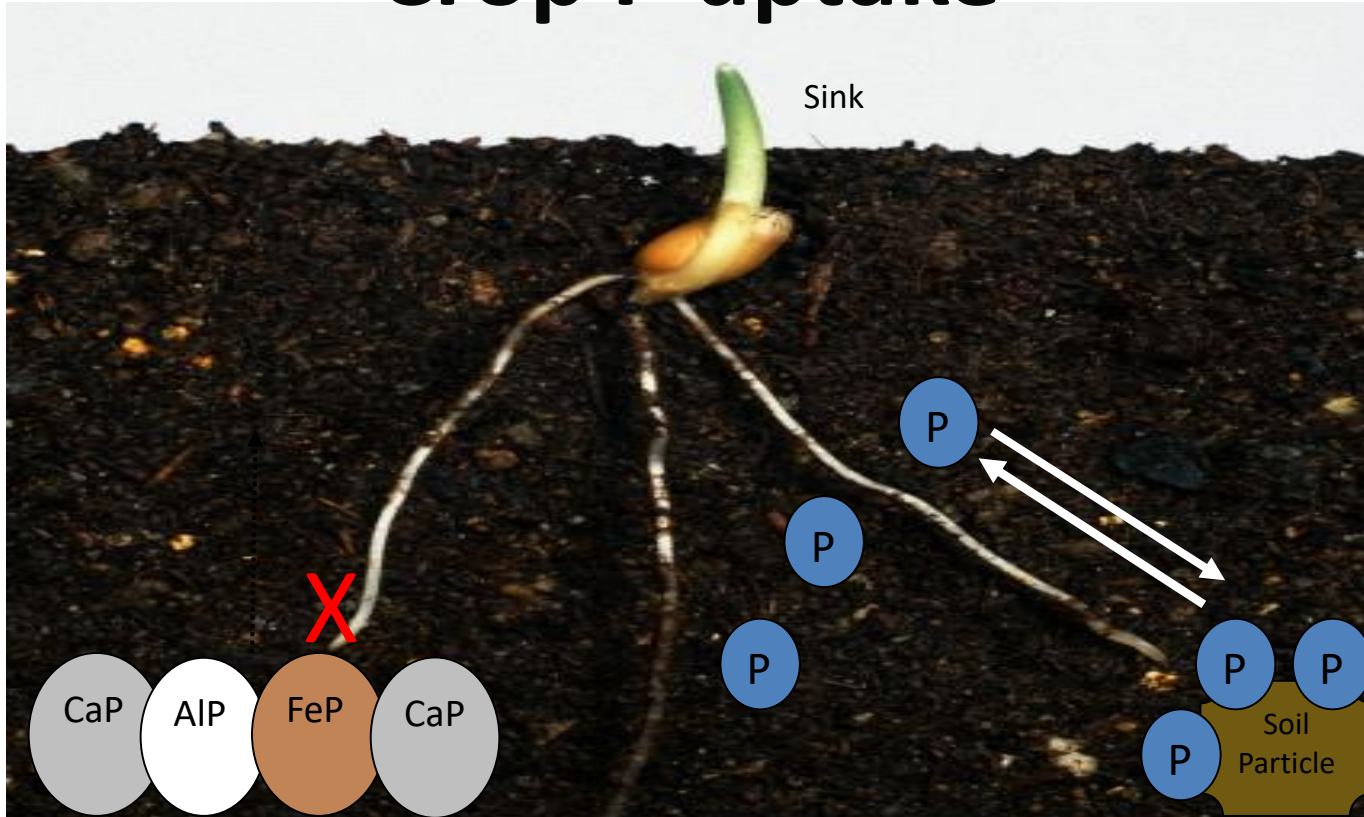
- Exchangeable K
 - Ammonium Acetate
 - Ammonium Chloride/Barium Chloride, WA adoption due to Aluminium

Current K lab methods

- DGT K

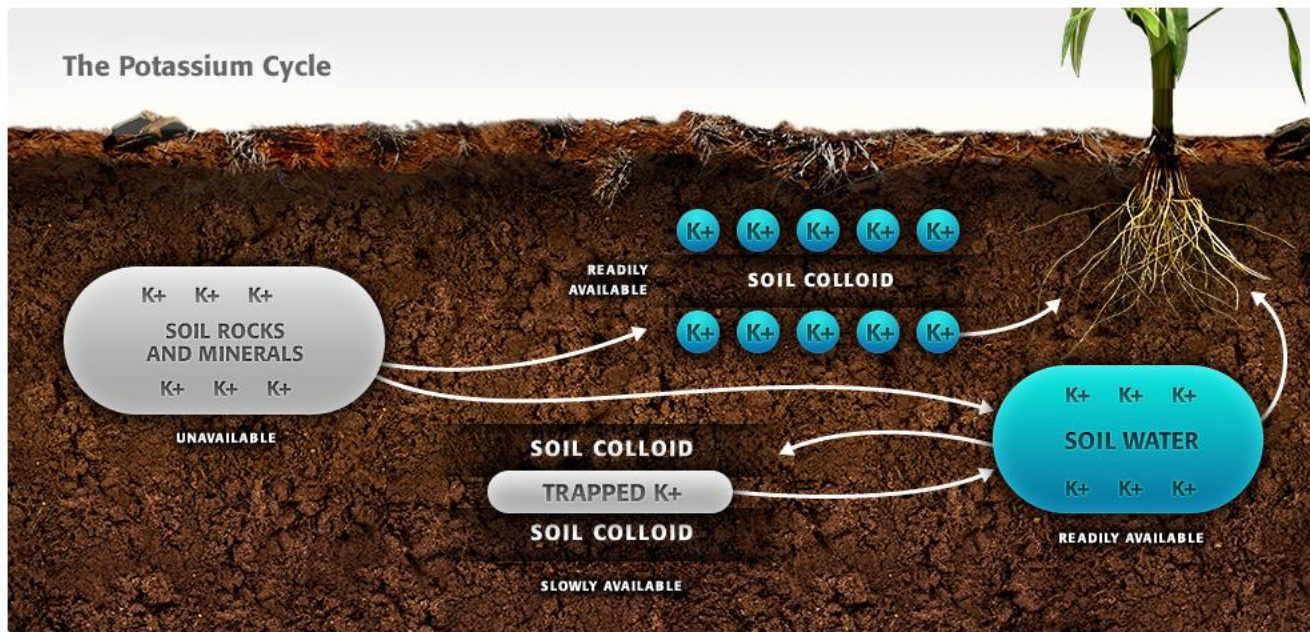


Crop P uptake



Potassium pools

Potassium supply to a crop



Structural K

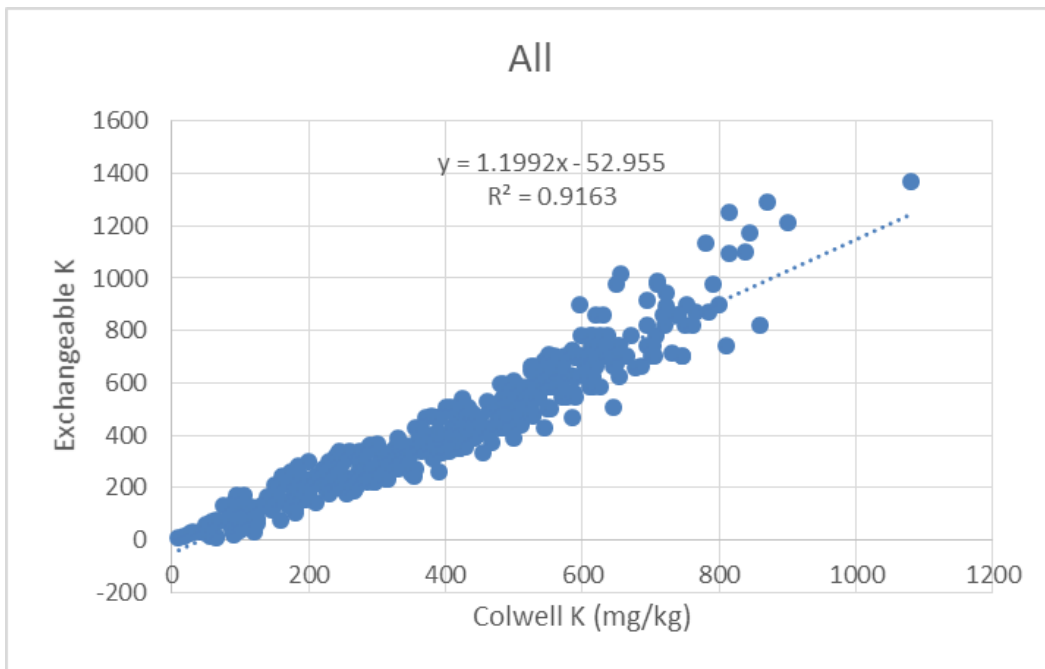
Interlayer K

Exchangeable K

Solution K

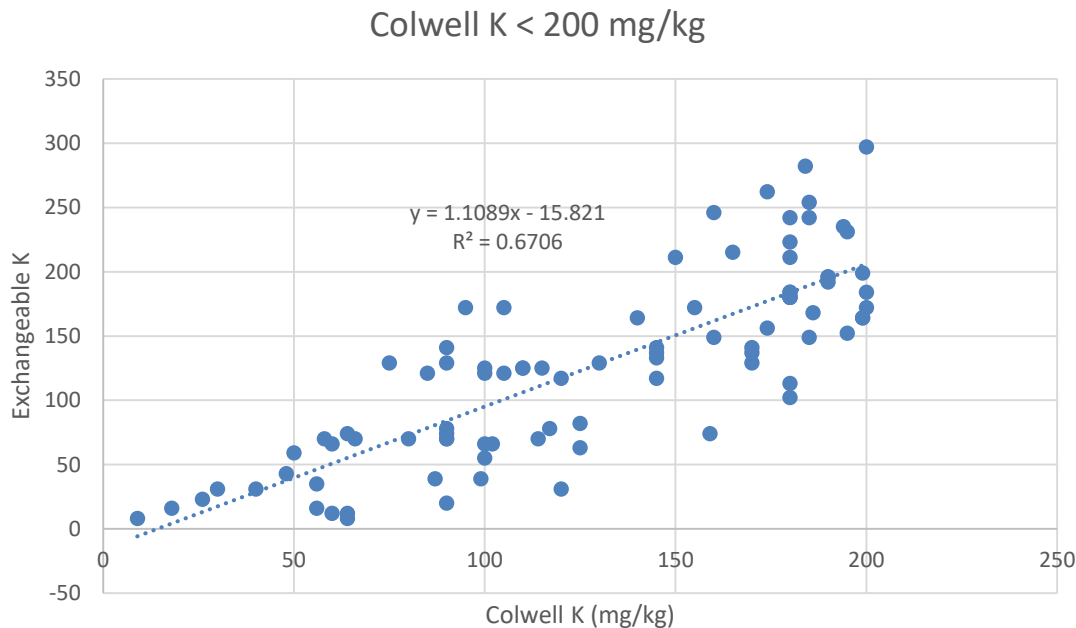
Is there a relationship between the methods?

- BFDC summary



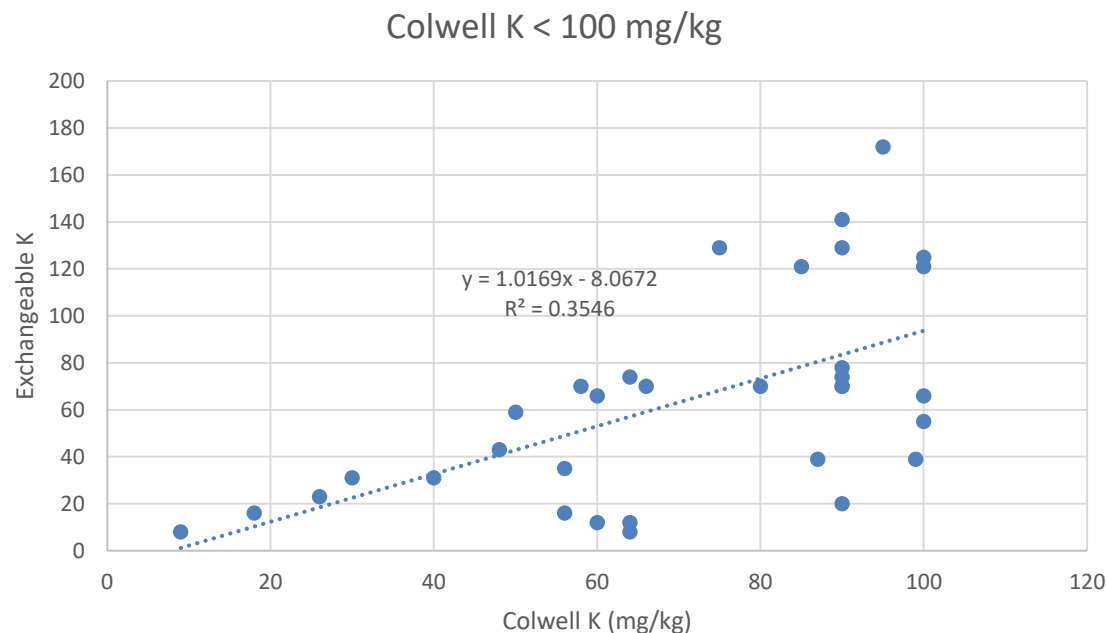
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- BFDC summary



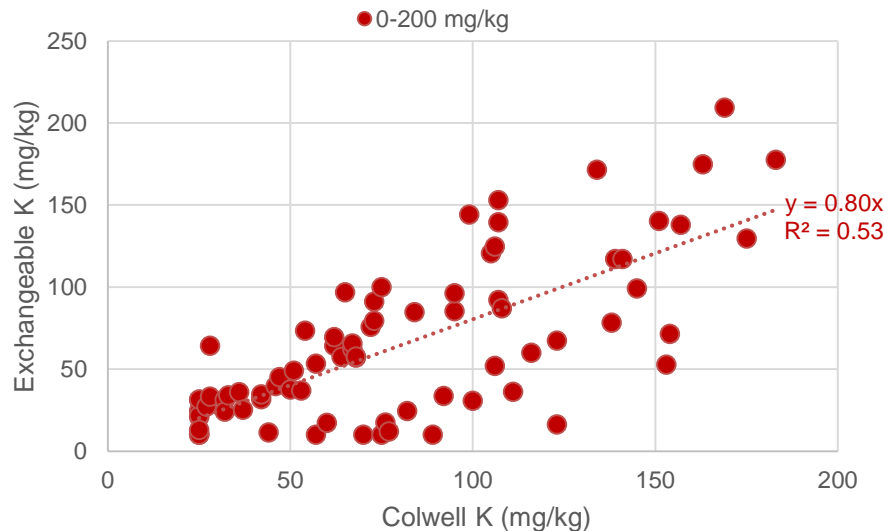
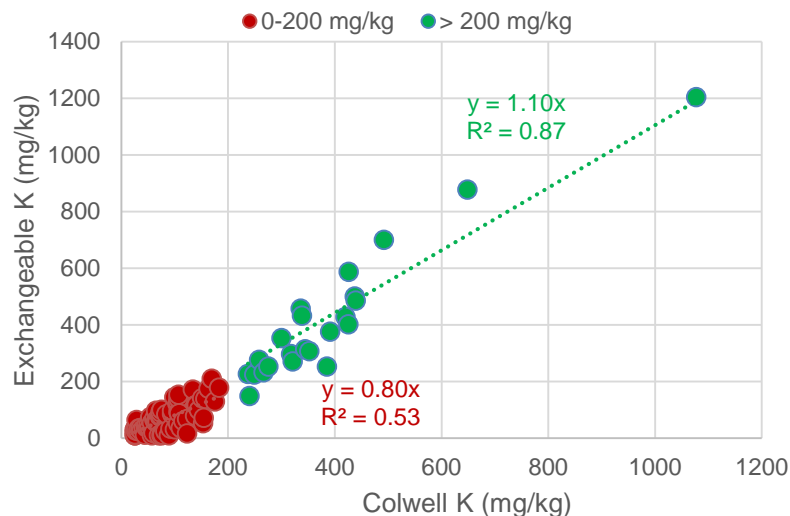
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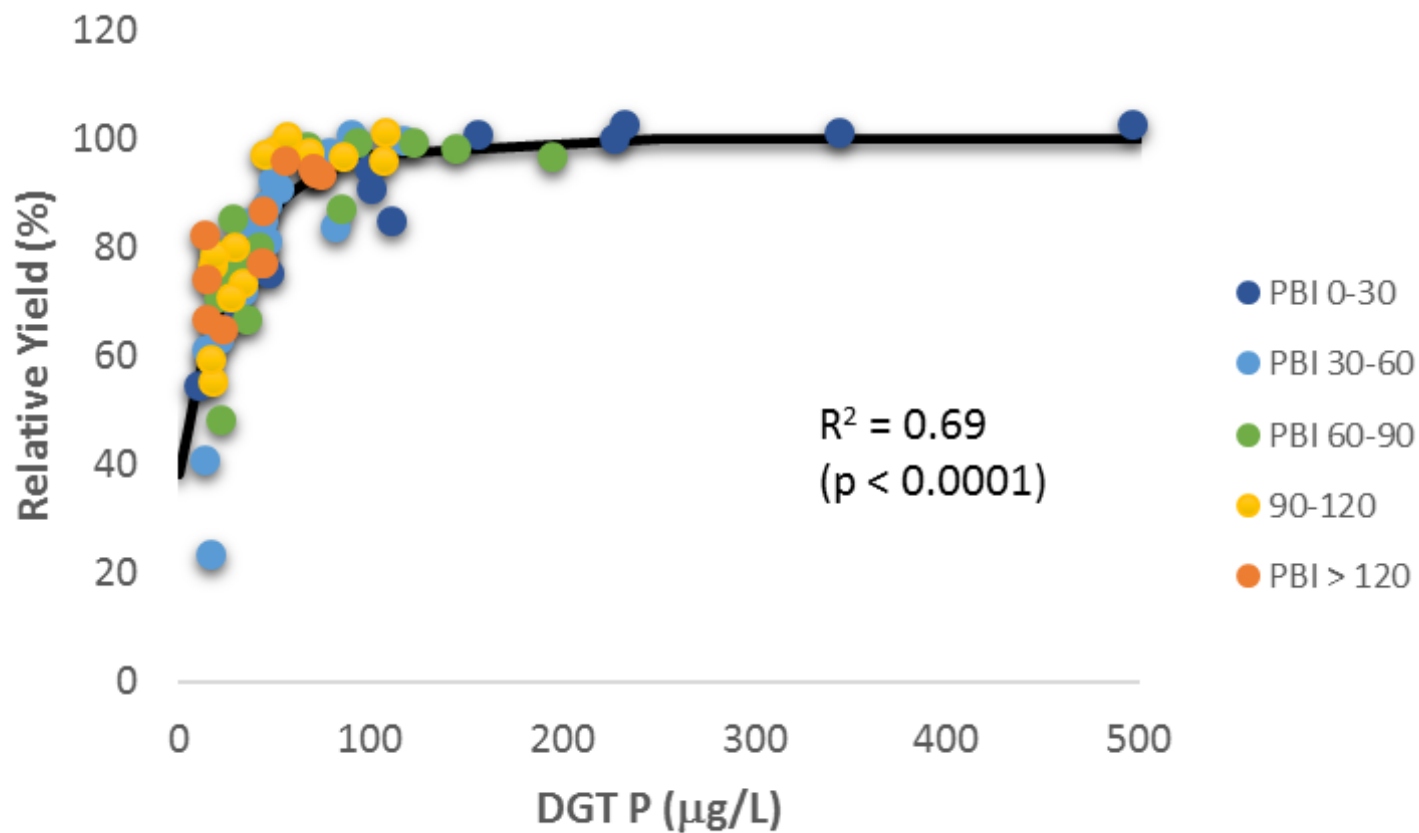
- BFDC summary



Is there a relationship between the methods?

- Local Data WA





Investigation – The trial

Site Characterisation & soil K manipulation

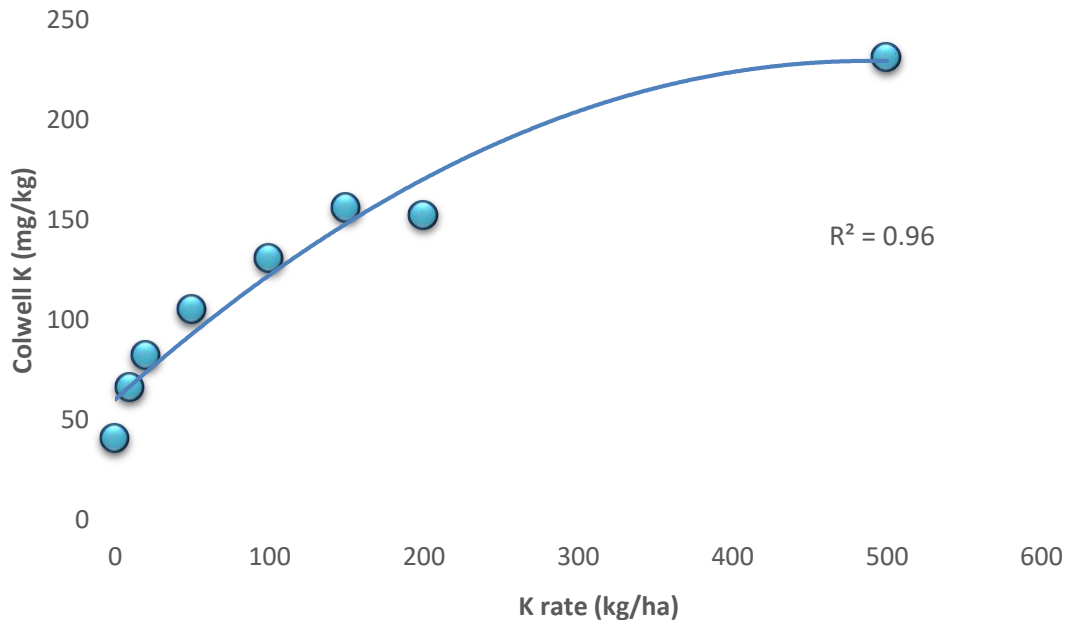
K averaged at 20-25 mg/kg (control plots)

| TMT | K | At seeding – banded product kg/ha | | | | Blended | IBS | PSPE | 4-5 WAE |
|-----|-----|-----------------------------------|----------|-----------|-----------|---------|---------|---------|---------|
| | | N | N,S | N,P,S | N,P,K,S | K | K | K | N |
| 1 | 0 | 35 Urea | 15 MAXam | 50 MAPSZC | | | | | 85 UAN |
| 2 | 10 | 35 Urea | 9 MAXam | | 85 Vigour | | | | 85 UAN |
| 3 | 20 | 35 Urea | 9 MAXam | | 85 Vigour | 20 MOP | | | 85 UAN |
| 4 | 50 | 35 Urea | 9 MAXam | | 85 Vigour | 40 MOP | 40 MOP | | 85 UAN |
| 5 | 100 | 35 Urea | 9 MAXam | | 85 Vigour | 60 MOP | 120 MOP | | 85 UAN |
| 6 | 150 | 35 Urea | 9 MAXam | | 85 Vigour | 60 MOP | 160 MOP | 60 MOP | 85 UAN |
| 7 | 200 | 35 Urea | 9 MAXam | | 85 Vigour | 60 MOP | 260 MOP | 160 MOP | 85 UAN |
| 8 | 500 | 35 Urea | 9 MAXam | | 85 Vigour | 60 MOP | 460 MOP | 460 MOP | 85 UAN |

Investigation – The trial, K manipulation

2 cores per plot, 6 treatment reps - every plot sampled and analysed in 0-10

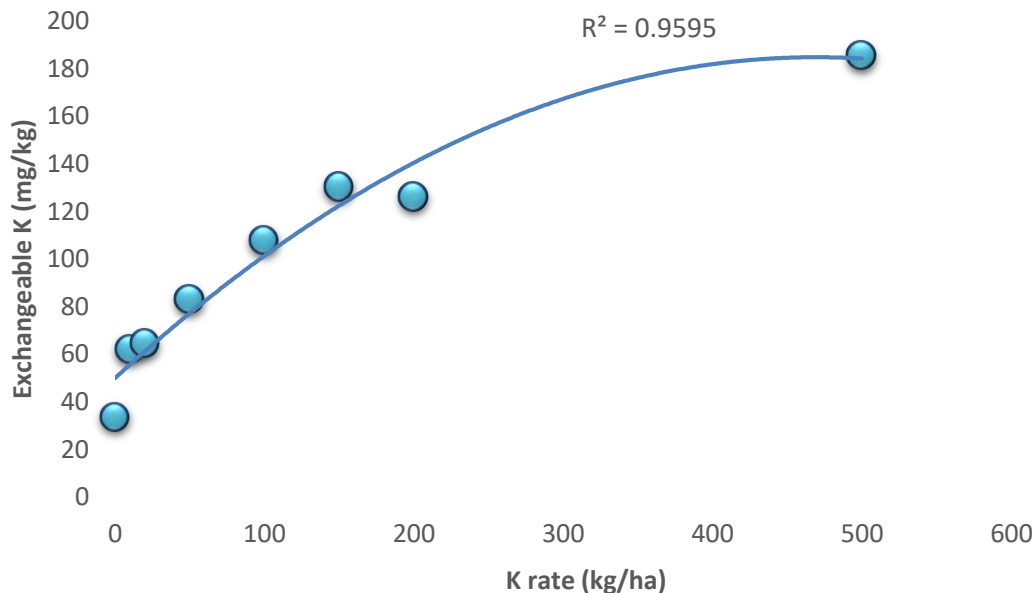
Sampling time July 17



Investigation – The trial, K manipulation

2 cores per plot, 6 treatment reps - every plot sampled and analysed in 0-10

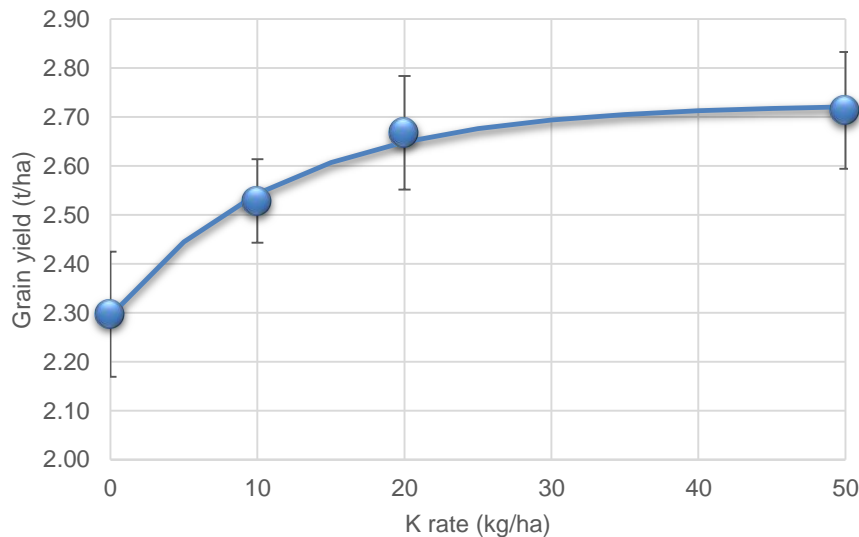
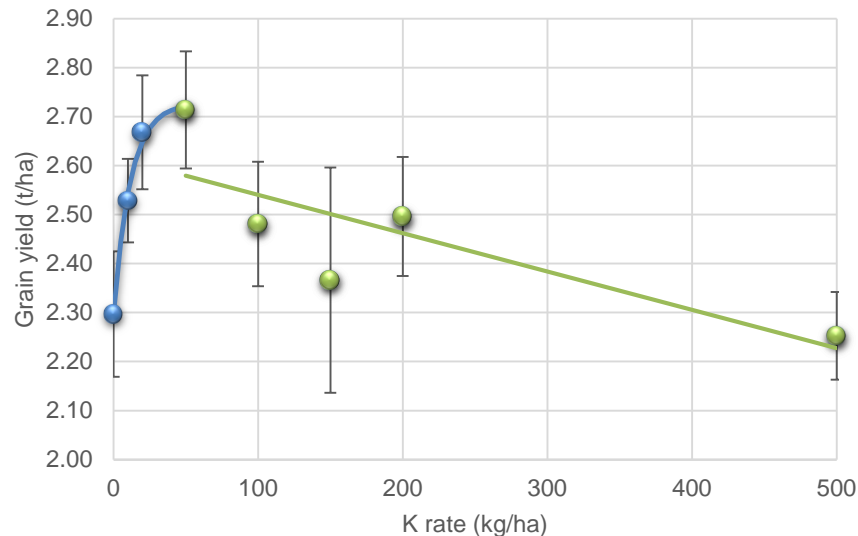
Sampling time July 17



Investigation – Yields and response

Response up to 50 kg/ha K

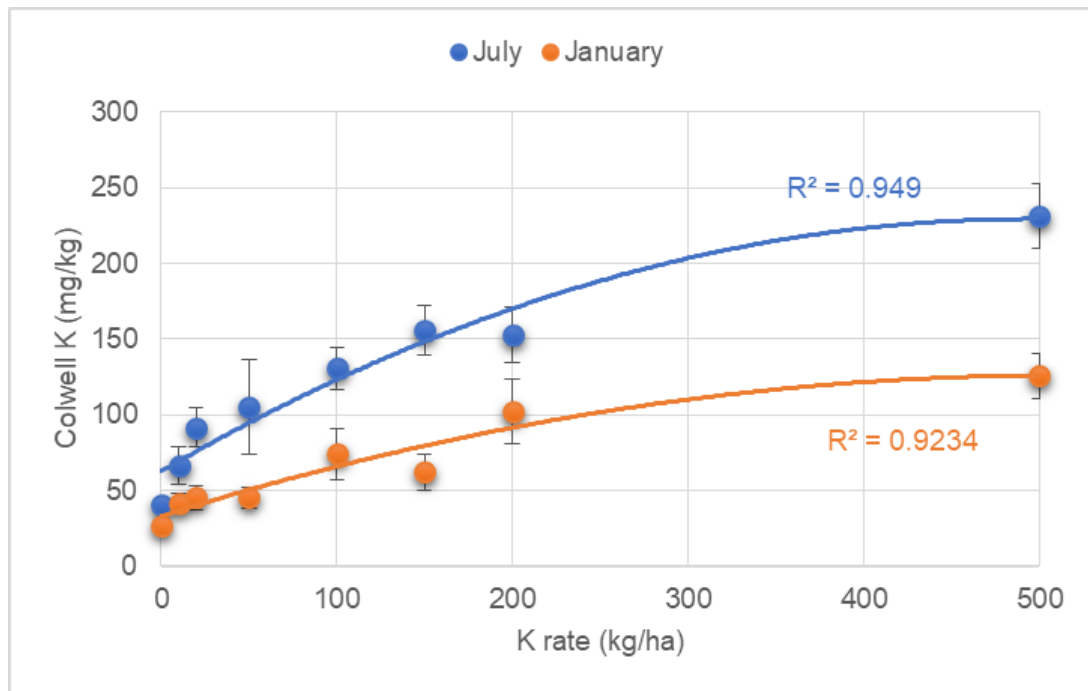
Yield reduction with higher rates



Investigation – Soil testing, January 18

0-10cm comparison

2 cores per plot, 6 treatment reps - every plot sampled and analysed in 10cm increments to 50cm

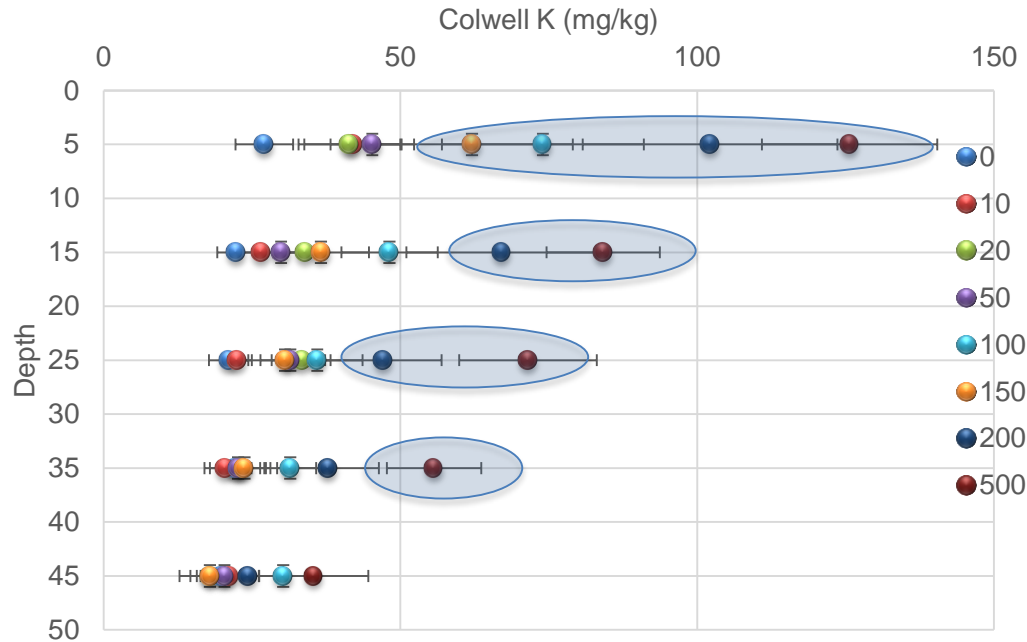


Investigation – Soil testing, January 18

2 cores per plot, 6 treatment reps, every plot sampled and analysed in 10 cm increments to 50cm

Sampling time Jan 18, 1040 K tests

Soil test value decrease from 220 to 125 from July sampling

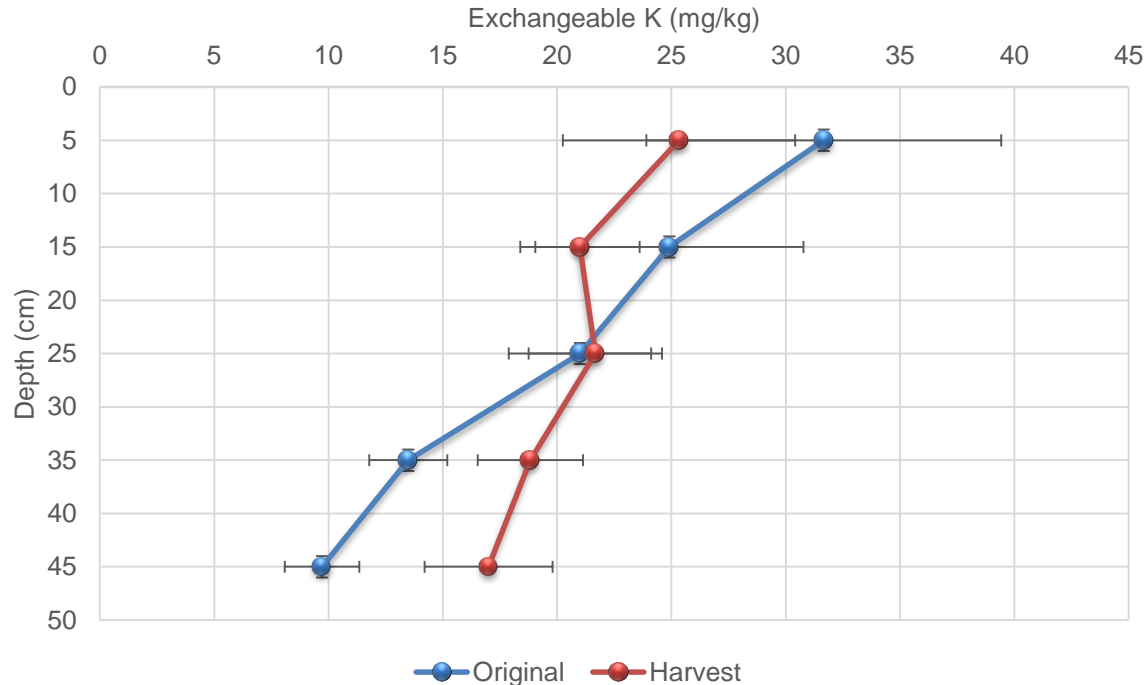


$P < 0.05$ to control

Investigation – Soil testing, January 18

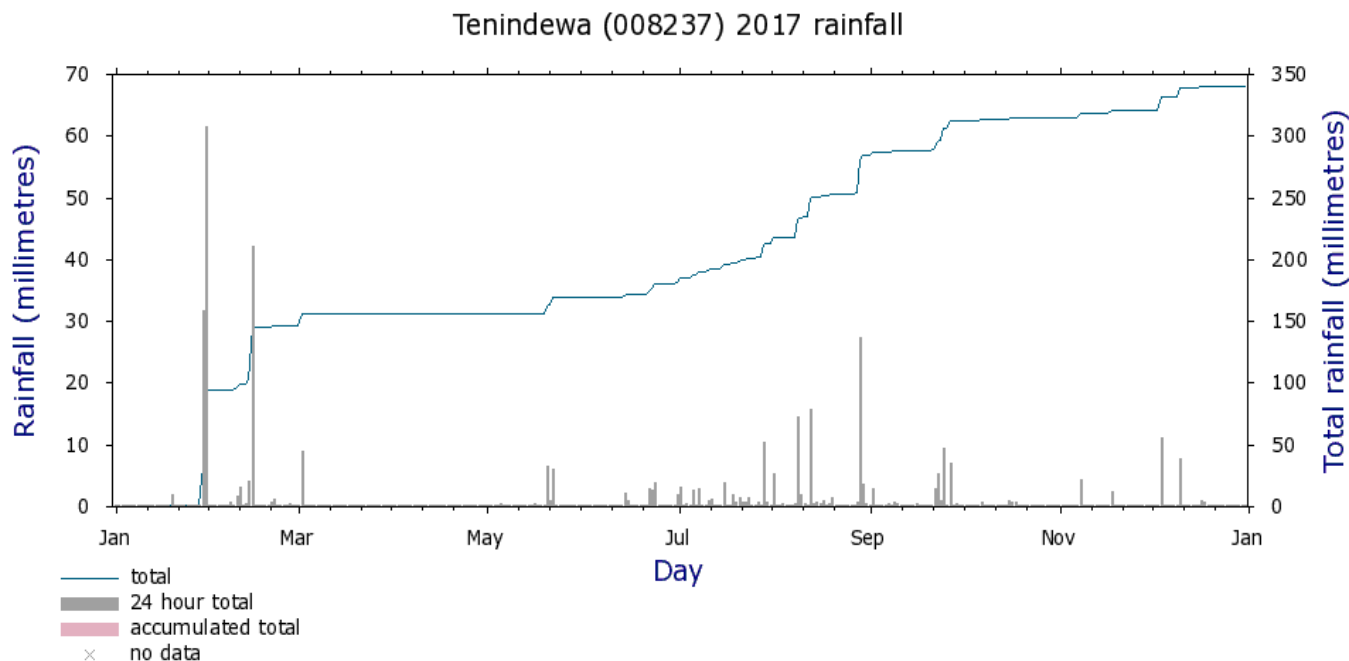
Comparison to original site classification, 0 K treatment

History – 20 kg/ha K annually



Investigation – Rainfall

175 mm since July sampling



Note: Data may not have completed quality control.

Climate Data Online, Bureau of Meteorology
Copyright Commonwealth of Australia, 2018



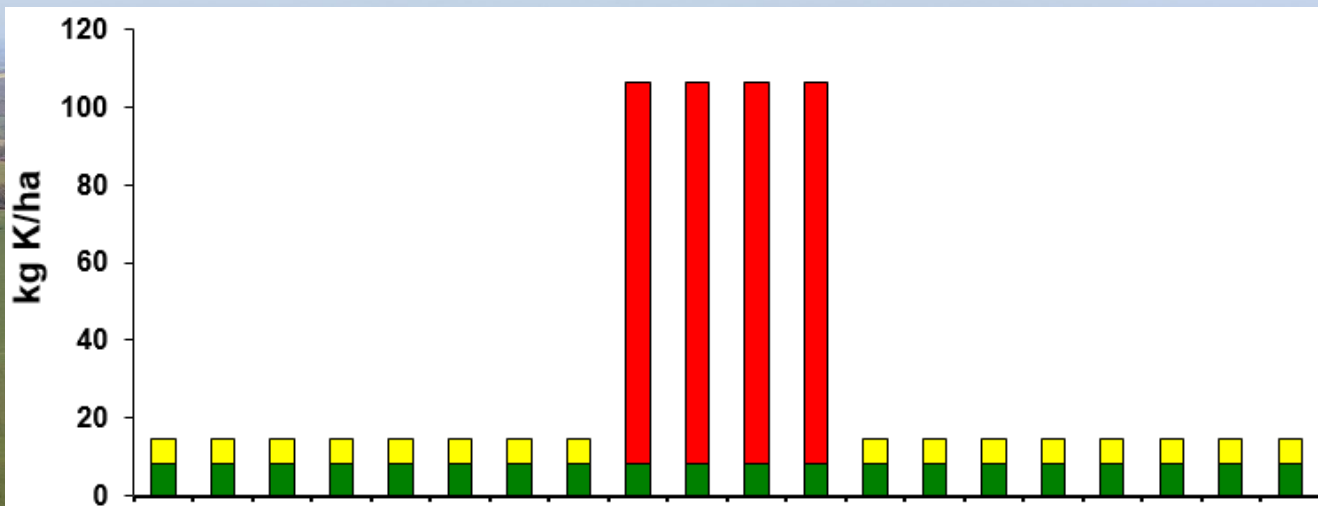
Wayne Pluske, Equii
Ryan Walker, Apal Laboratories
John Young, Wyening Mission Farm





8 kg/ha K drilled every year
30 kg/ha K topdressed in 2012
25 kg/ha K topdressed in 2014
25 kg/ha K topdressed in 2016
Occasional windrow burn

Photo: Erin Cahill (agVivo) 2016



For a 2 t/ha wheat crop

Photo: Erin Cahill (agVivo) 2016

Our direct measurement approach:

- Calingiri harvest, November 2017
- Canola and wheat
- Measured:
 - Stems/leaves/pods to be harvested
 - Grain yield
 - Soil-attached residue remaining after harvest
 - Straw/chaff out the back of header
 - Nutrient concentrations
- Estimated how much nutrient was flushed from straw/chaff after a “rain”
- **To gauge the cost of nutrient redistribution, in fertiliser equivalents, of windrowing**



Quantities and concentrations – Nutrient redistribution

| | Dry matter (t/ha) | N (%) | P (%) | K (%) |
|------------------------------------|-------------------|-------|-------|-------|
| Canola | | | | |
| Soil-attached residue | 2.6 | 0.49 | 0.02 | 1.33 |
| Harvestable biomass: | | | | |
| Stems/leaves/pods – direct-headed | 2.9 | 0.49 | 0.03 | 1.48 |
| Stems/leaves/pods – swathed | 2.8 | 0.58 | 0.04 | 1.22 |
| Seed | 1.3 | 3.27 | 0.59 | 0.72 |
| Straw/chaff out the back of header | 3.1 | 0.59 | 0.03 | 0.95 |
| Wheat | | | | |
| Soil-attached residue | 2.5 | 0.63 | 0.01 | 1.03 |
| Harvestable biomass: | | | | |
| Stems/leaves/pods – direct-headed | 2.3 | 1.27 | 0.13 | 0.67 |
| Seed | 4.5 | 1.80 | 0.24 | 0.44 |
| Straw/chaff out the back of header | 2.4 | 0.40 | 0.02 | 1.72 |

kg/ha of total NPK on and off windrows (includes soil attached residue)

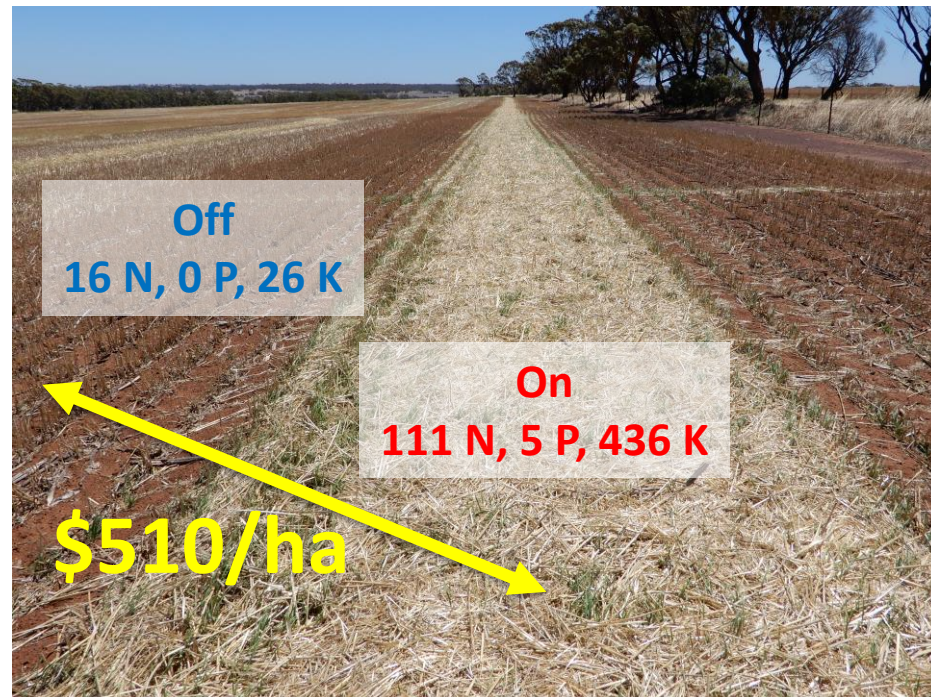
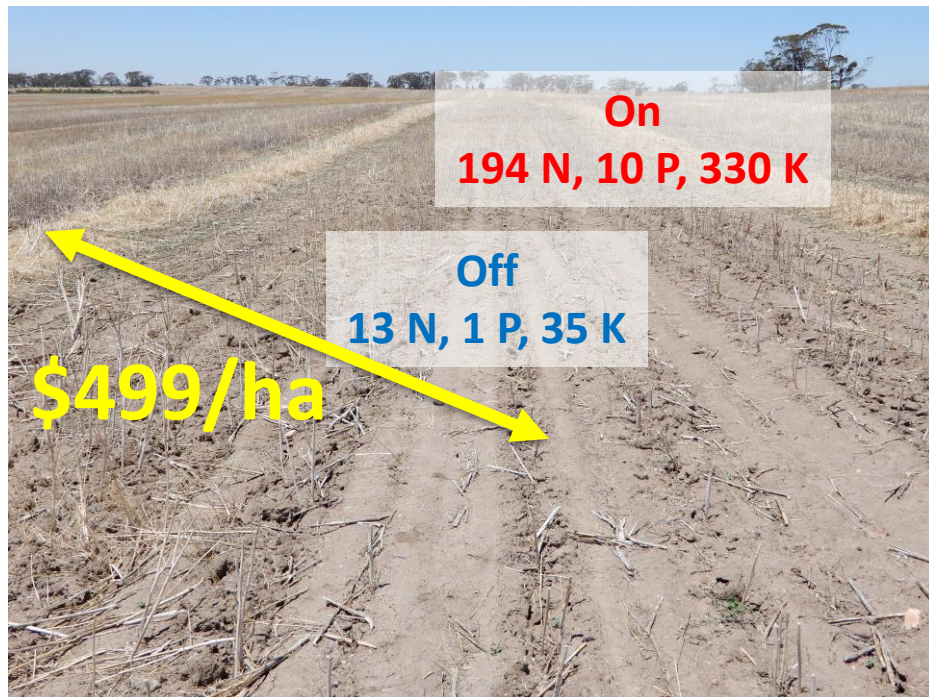


Even spread: 31 N, 2 P, 64 K

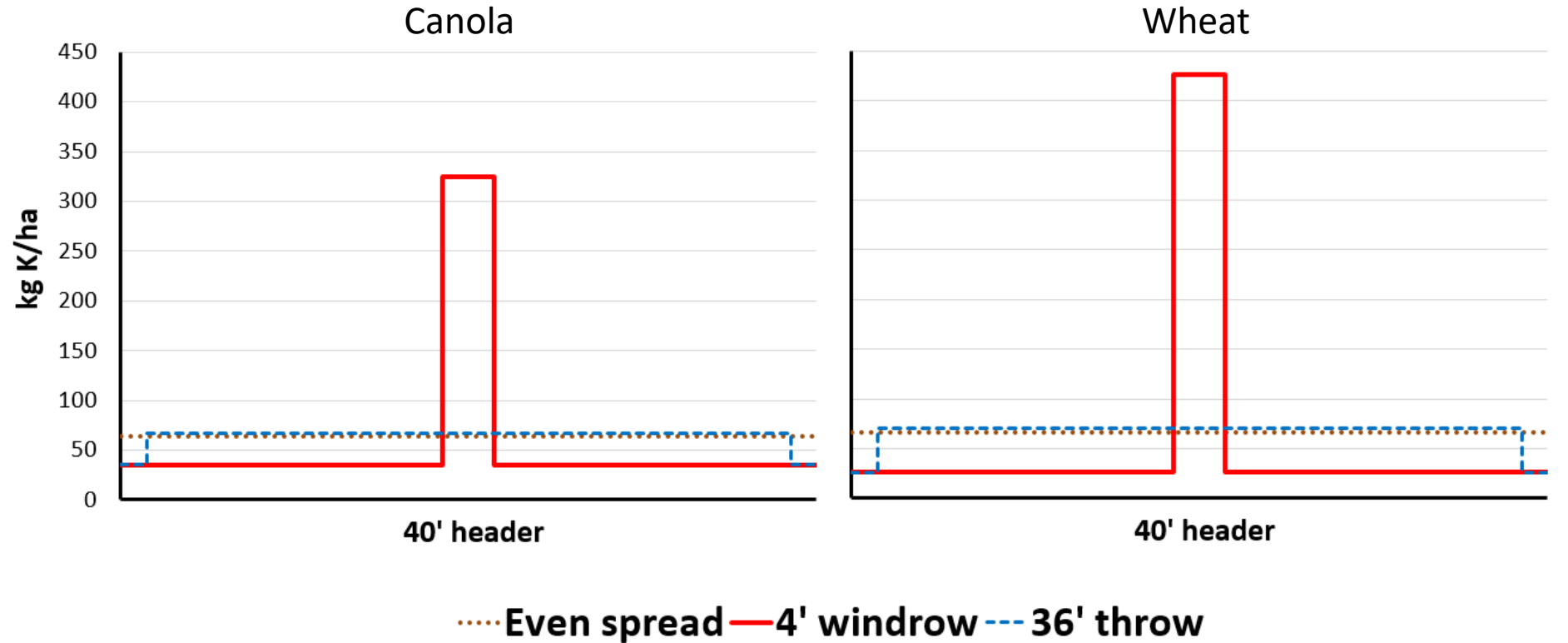


25 N, 1 P, 66 K

kg/ha of total NPK on and off windrows (includes soil attached residue)

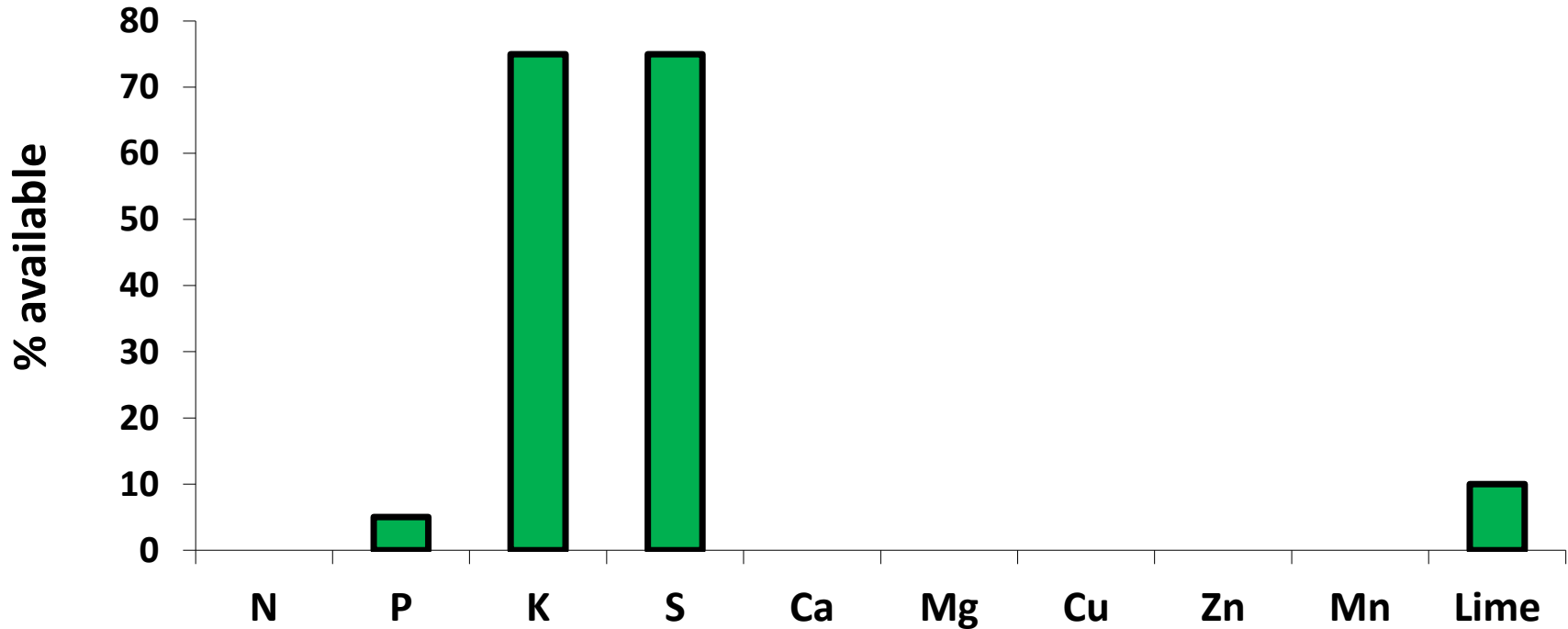


Redistribution of total K out the back of the header



How plant-available are nutrients?

Historical/conventional thinking



Pluske and Bowden

How plant-available are nutrients?

- We mimicked a single reasonable rainfall event
 - Canola straw/chaff
 - Ground samples (20g) shaken with Milli-Q water (100ml) on an end-over-end shaker for 24 hours
 - Soluble extract decanted and centrifuged at 4000 rpm for five minutes
 - Solution analysed
- **To gauge the cost of nutrient redistribution, in fertiliser equivalents, of windrowing**

Nutrient extracted in a mimicked single rainfall event

Canola

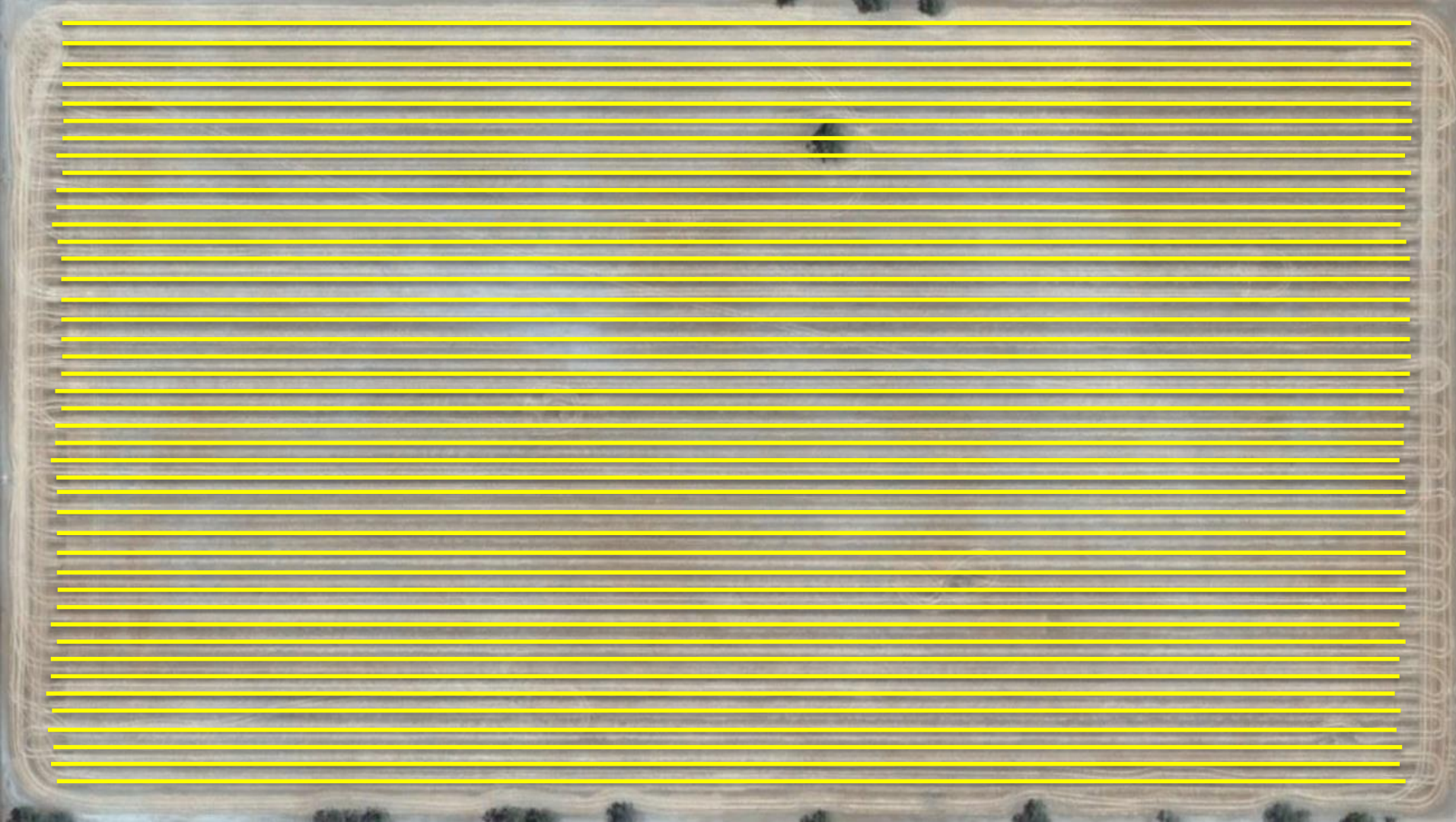
8% N

32% P

55% K

| | N (%) | P (%) | K (%) |
|------------------------------------|------------|-----------|------------|
| Straw/chaff out the back of header | 0.59 | 0.03 | 0.95 |
| After 65mm rain (15/1/18) | 0.48 | 0.03 | 0.41 |
| % loss | 19% | 0% | 57% |

500 - 1,000 kg/ha MoP?



Summary

Trial to continue with Lupins in 2018 (3-5 years)

Soil K levels established – no K application ongoing to review responses to soil test levels

Track K movement (leaching) down the profile with rainfall
K Buffering INDEX?

A lot to learn about the K cycle – tools to differentiate soils and response

Sampling strategies – Are we going deep enough to budget for K?

Research funded by:



Special thanks to contributors:

Agrarian Management

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