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Managing non-wetting and crop nutrition of forest gravels

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Key Messages

- Wetting agents can be effective and economical, but timing with respect to rainfall (i.e. apply shortly before rain) appears to be critical.

- The use of a mouldboard plough while eliminating or reducing non-wetting created sometimes other not yet fully understood problems.

- Lifting the soil pH to above 4.8 in combination with soil cultivation maximised the yield.

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Symptoms of non-wetting soils:

- Soils wet up slowly and more rainfall is needed to fully wet the soil.
- Weed, crop and pasture germination is patchy, variable and delayed.
- Reduced nutrient availability and inefficient nutrient uptake.
- Reduced crop and pasture productivity.
- Increased risk of wind and water erosion.

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Forest gravels, associated with forests (old) and gravels

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Soil types:

- Usually loamy shallow gravelly duplex soil,
- Variable range of PBI (Phosphorus Buffer Index), tends to be high (100 - 300).
- Located in high rainfall
- High productivity potential
- Soil constraints:
  - Gravel
  - Non-wetting
  - Waterlogging

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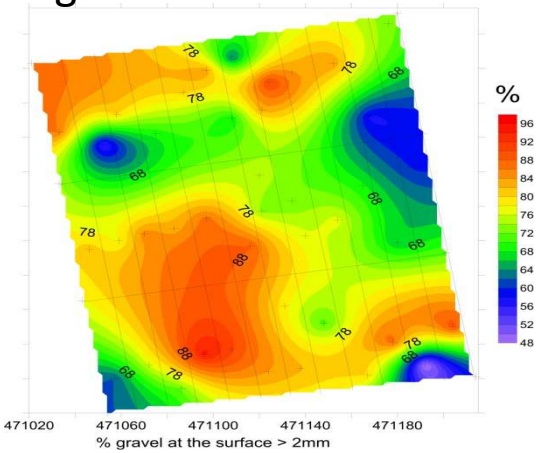
Range of gravels at the surface



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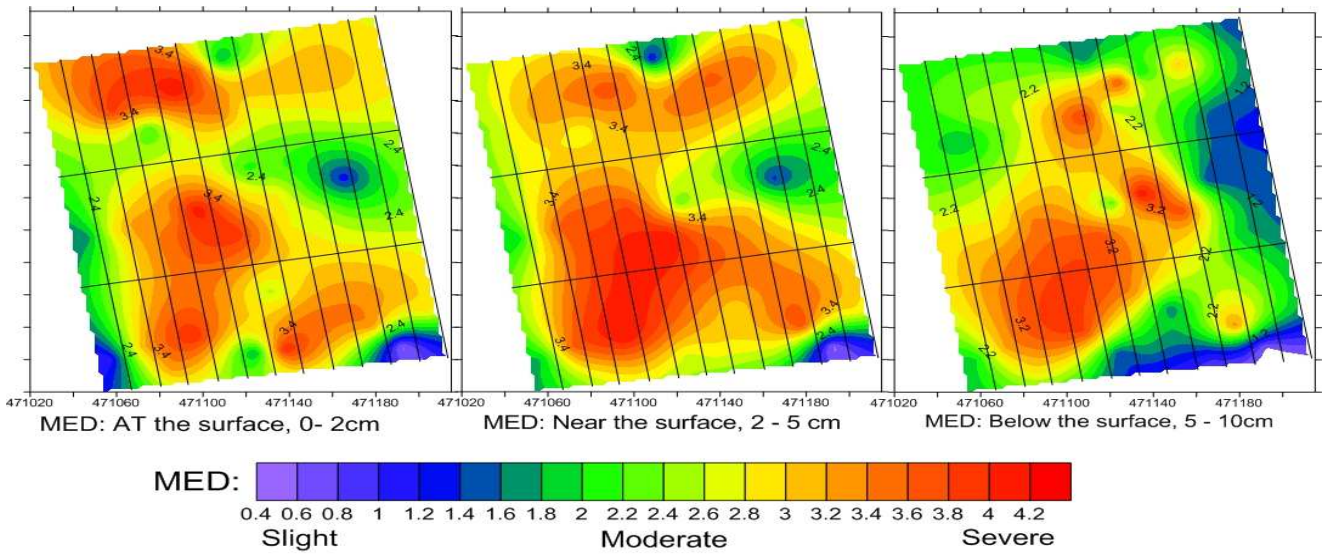

Distribution of the non-wetting properties before the treatments

MED =

Molar Ethanol Droplet

No correlation between gravel content and MED

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Managing Water Repellence

Mitigation Options (Live with it)	Amelioration Options (Change it)
Improved furrow sowing	Clay spreading or delving
Banded wetting agents	Soil inversion (Mouldboard plough)
Blanket-applied wetting agents	Rotary spading
Full retention/minimal disturbance	
On-row seeding	

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- Wetting agents: easy to apply, rate responsive, sometimes effective, sometimes economical.

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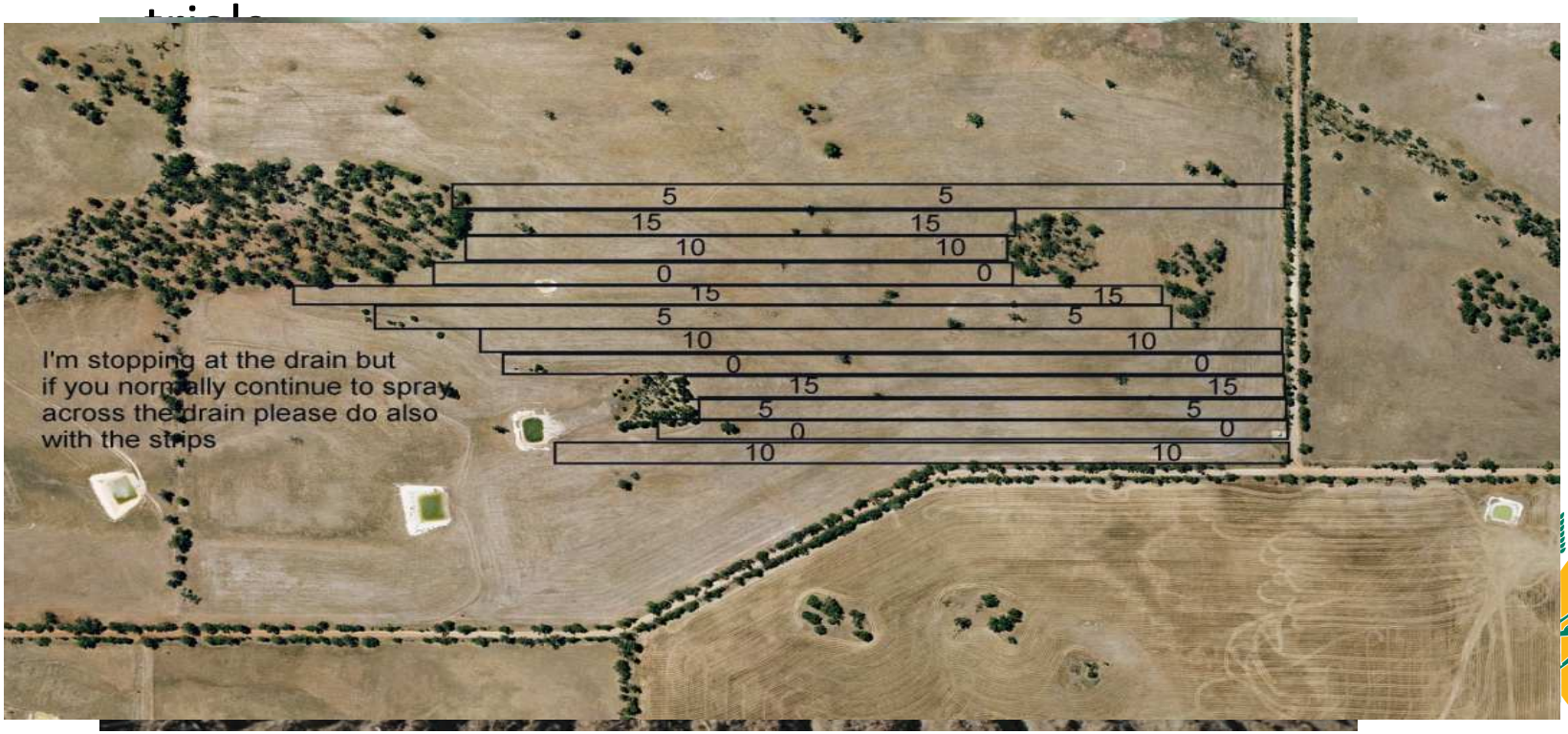
Wetting agent: Small scale lab test, small plot trials and large strip trials



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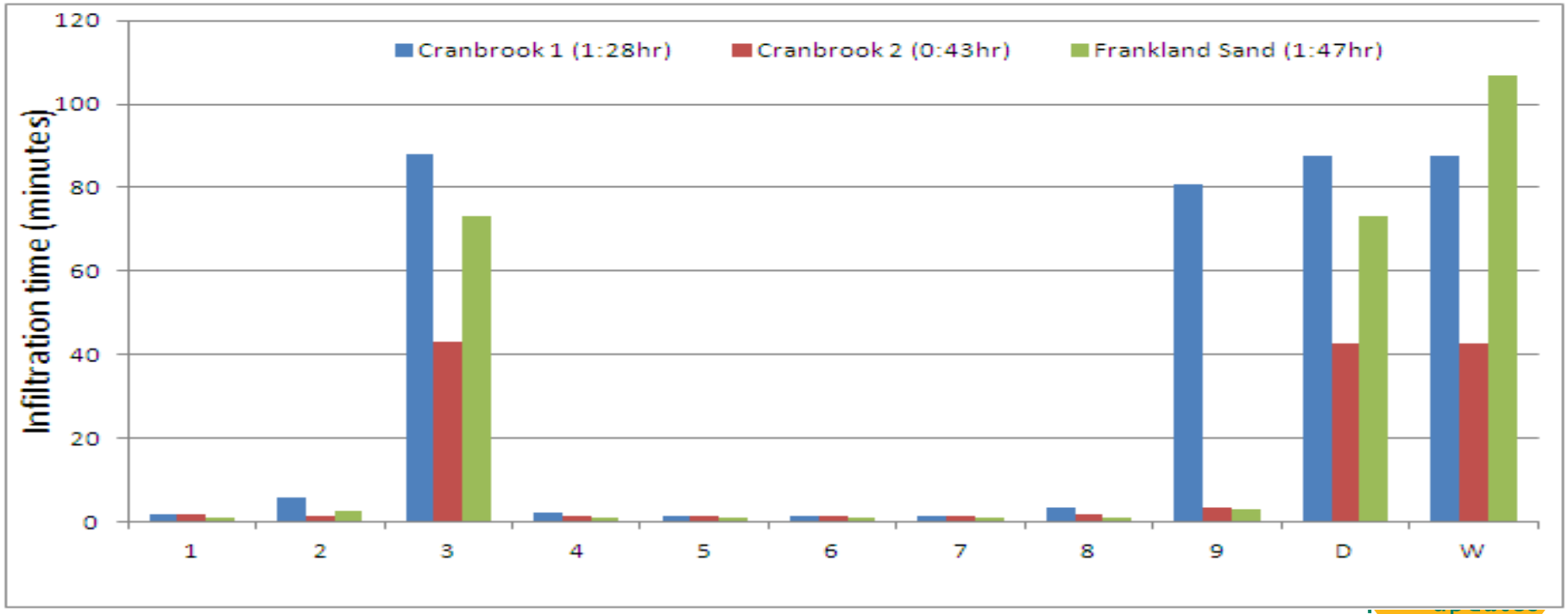
Some results from Lab tests (time of infiltration of a large droplet)



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Some yield (t/ha) results from small plot trials (2012):

Crop	Wheat	Barley	Wheat	Wheat	Barley	Barley
Variate	Nyabing	Cranbrook	Frankland_Gravel	Frankland_Sand	South_Stirling	Darkan
Fpr.	0.939	0.484	0.007	0.694	0.916	0.627
Contrast	0.309	0.032	0.001	0.329	0.977	0.58
Biagra	2.63	2.52	3.38	0.92	2.89	4.39
Control	2.79	2.04	2.76	0.75	2.69	4.57
Irrigator	2.67	2.50	3.25	0.74	2.87	4.71
Lure	2.70	2.47	3.09	0.87	2.41	4.07
Precision Wetter	2.69	2.45	3.59	0.81	2.56	4.44
SeedWet	2.58	2.64	3.11	0.96	2.78	4.55
Spray wet	2.67	2.58	3.25	0.95	2.60	4.43
lsd (WA)	0.34	0.58	0.40	0.33	0.57	0.68

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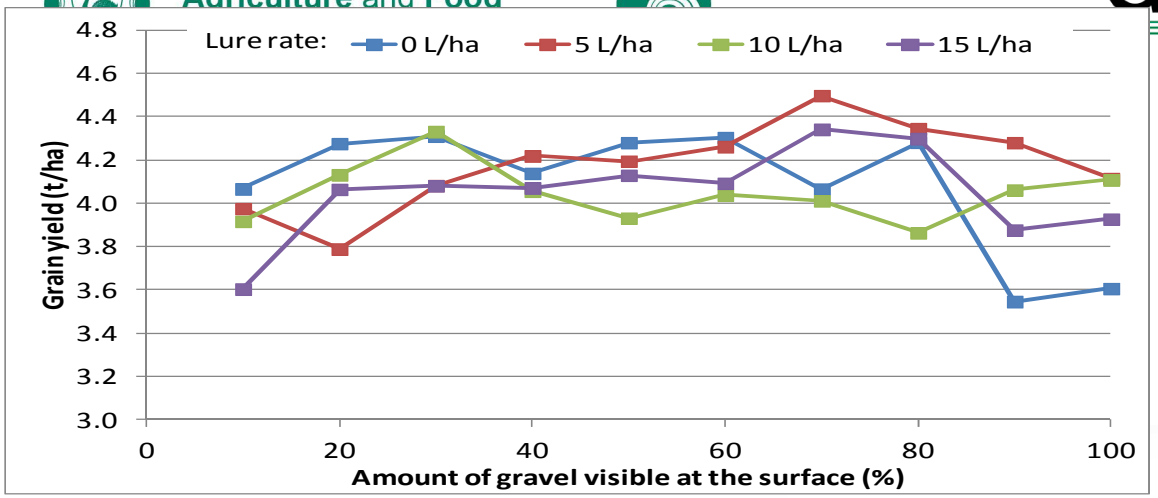

Results from large plot trial in 2011 in Kojonup with LureH2O.

(80 – 100%) (4.2 ha) of the *surveyed* area (20 ha) an extra $480 (2 t grain @ $240/tonne)

After spending $100 on the LureH2O (5 l/ha @ $5/L)).

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- Soil Management to address Non-Wetting Forest Gravels

Several treatments were applied in 2012 and 2013 to forest gravels at Cordering.

2012	2013
Control	Control
Balance 60kg/ha	MBP
Compost 2T/Ha	Lure 15L/Ha (Pre-Seeding)
Lime	Lure 15L/Ha (Post-Seeding)
Lime & MBP	Bentonite 1%
MBP	
Scarifying	3 reps each
PW 2.5L/Ha	70 m (2012) and 200 m (2013)
Lure & PW 15L & 2.5L/ha	13.5 m wide
Lure 15L/Ha	PW = Precision Wetter
Bentonite 1%	MBP = MouldBoard Ploughing
Bentonite 3%	

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- Mouldboarding while eliminating non-wetting resulted in poor establishment in some trials (soil temperature, seeding depth, compaction?)

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Trial results from SM1 ('12 & '13) and SM2 ('13)

SM1	2012	2013	2012	2012
Treatment	Wheat (T/ha)	Canola (T/ha)	pH CaCl2	MED
MBP+Lime	3.82	2.34	5.0	0.9
Balance	3.96	2.09	4.9	3.0
Lime (2 T/ha)	4.09	1.97	5.2	2.5
Scarify	4.26	2.24	4.9	2.8
Precision Wette	4.28	2.17	4.7	2.7
MBP	4.55	2.02	5.2	0.8
Compost	4.61	2.35	5.0	3.3
Lure & PW	4.71	2.29	4.9	2.8
Lure	4.74	2.60	4.7	2.3
Control	4.85	2.38	4.8	3.1
Bentonite 1%	5.06	2.54	6.3	3.1
Bentonite 3%	5.11	2.32	6.6	2.5
lsd	0.59	0.62	0.36	1.21

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Trial results from SM1 ('12 & '13) and SM2 ('13)

SM2	Canola yield, **2013**			
Treatment	Yield, T/ha	**MED (7/03)**	**MED (17/5)**	**pH(CaCl2)**
Bentonite 1%	2.41	4.2	1.1	5.6
Control	2.28		1.3	4.8
MBP	2.26		0.0	5.0
Lure Pre_Seeding	2.35		1.5	4.8
Lure Post_Seeding	2.42		1.2	4.7

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Crop nutrition of forest gravels

Ability to tie up Phosphorus is a major problem (high soil test P, still P responsive), however improving non-wetting, cultivating and liming was thought to partially overcome the unavailable P by improving root development.

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Yield results

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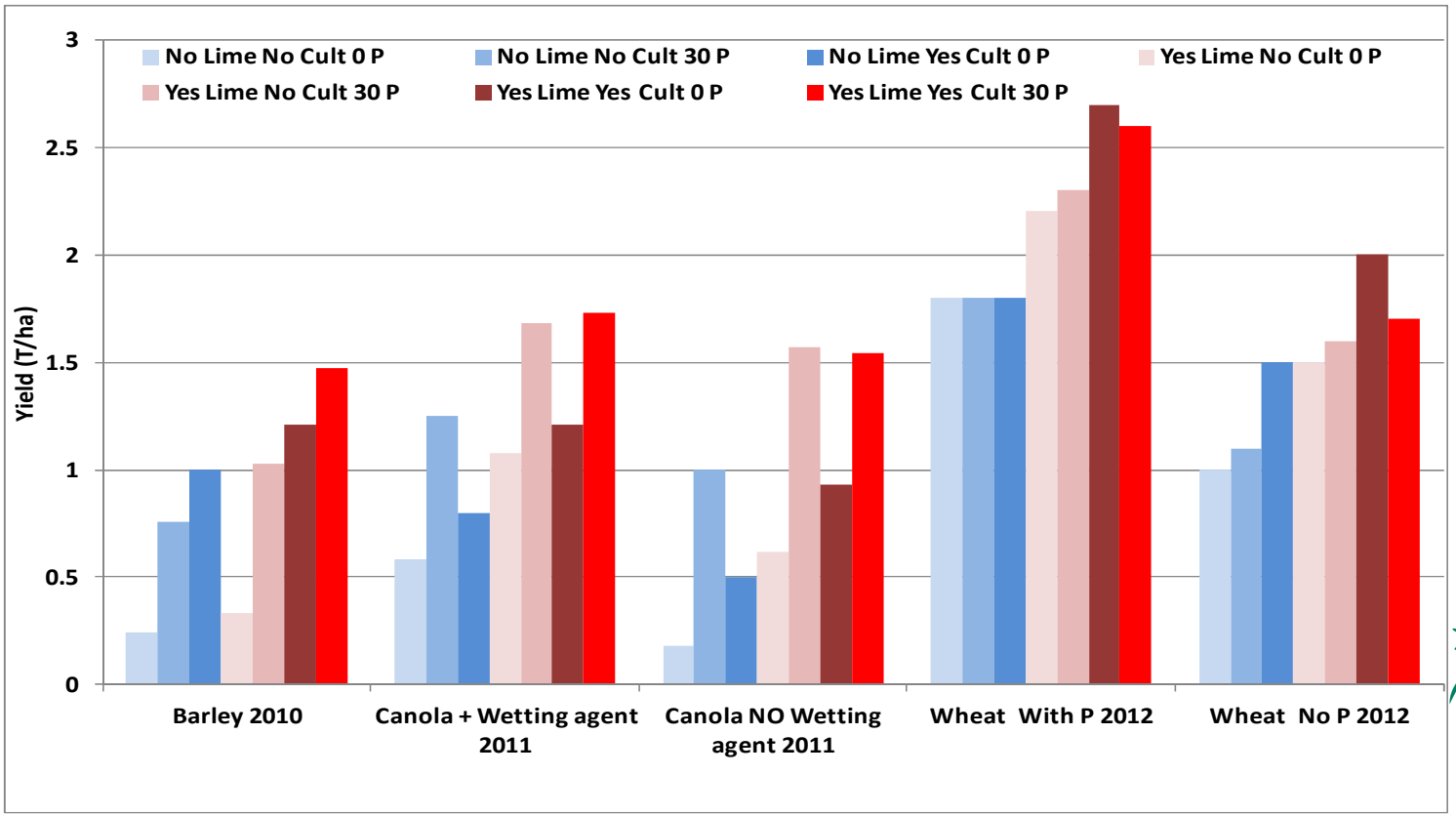

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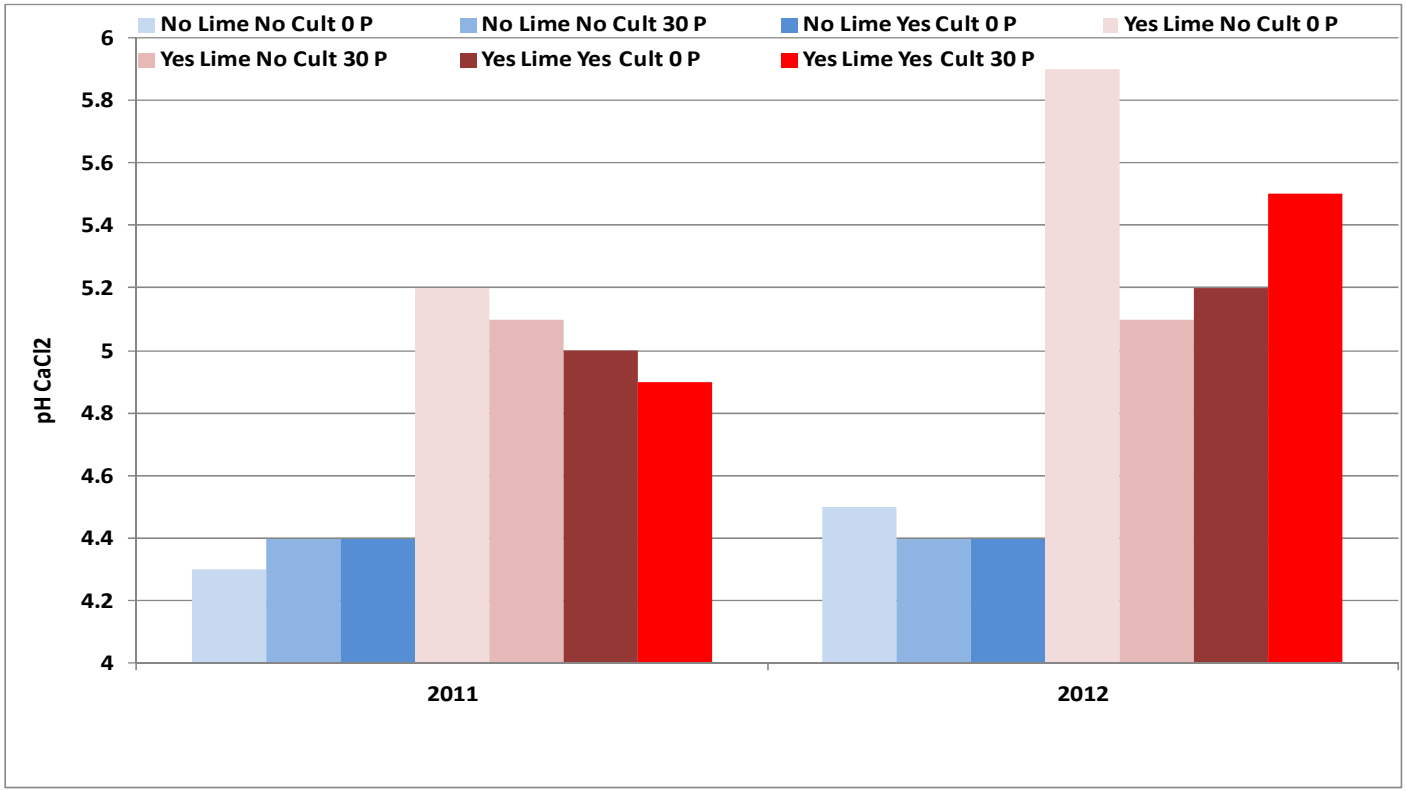

pH CaCl2 levels in 0-10cm (Lime = High Lime ("Builders Lime")

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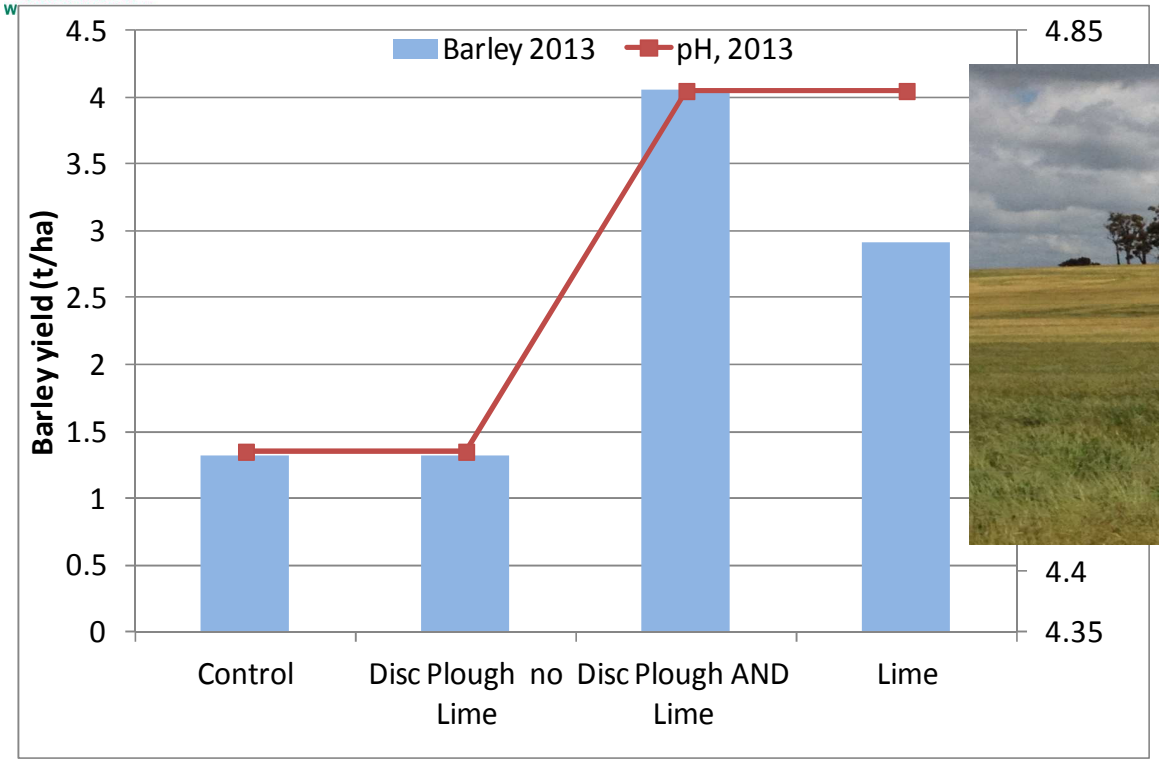

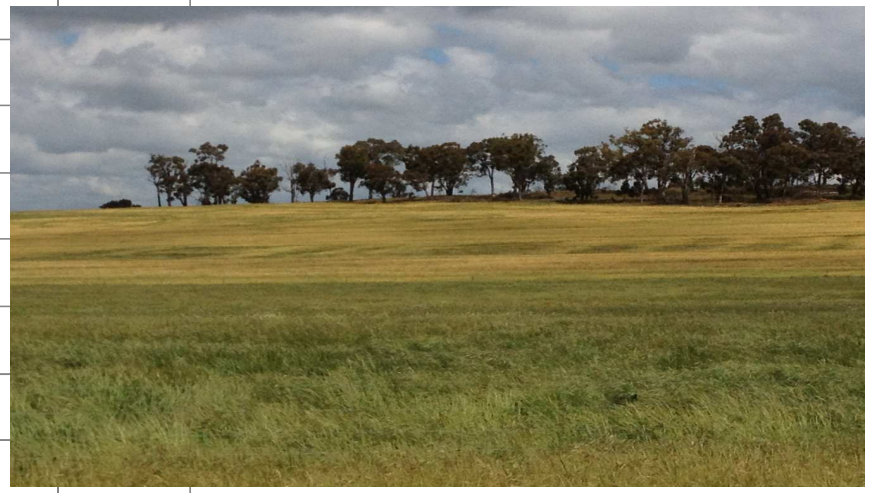

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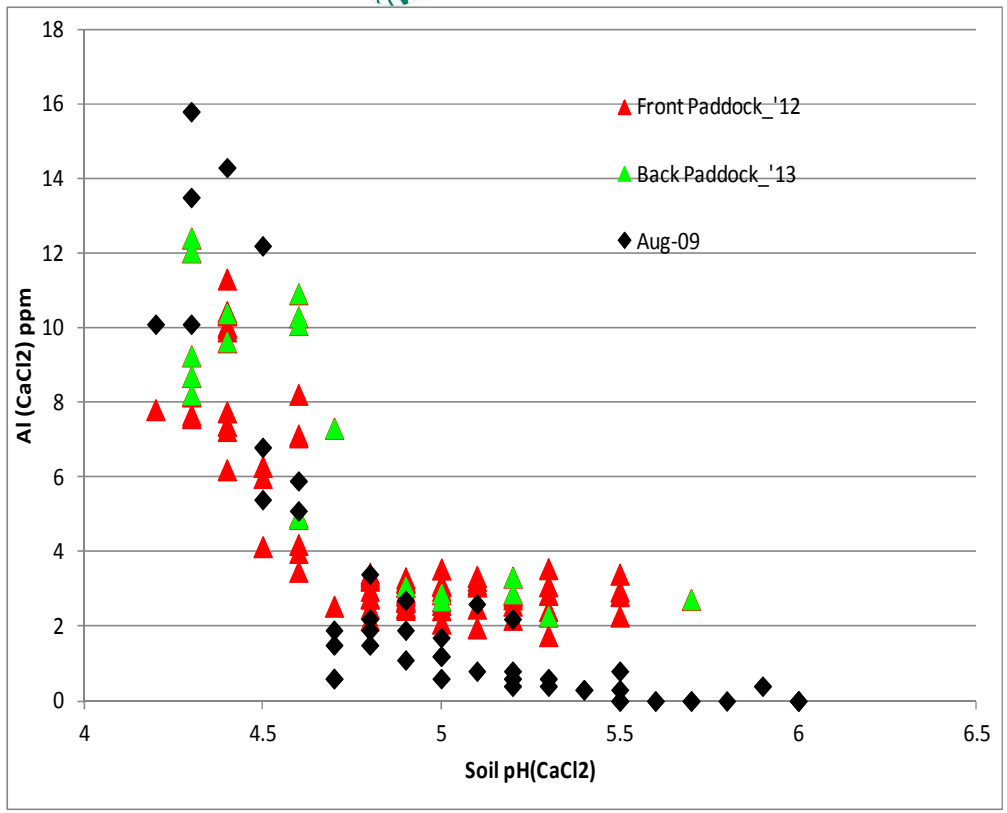
Disc Ploughed in 2009, normal lime, plots were cross sown and fertilised by farmer



Aluminium content vs Soil pH of Darkan soil

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Soil management and nutrition @ Frankland. Cultivation x Lime x Fertiliser, 4 reps

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The lime and cultivation did not compensate for a P-response but added to it.

Yield data from Cult x Lime x Fertiliser Trial, 2013

Cultivation	Yield (t/ha)	Applied_ Lime (t/ha)	Yield (t/ha)	Fertiliser (kg/ha)	Yield (t/ha)
Control	3.98	0	4.00	20	3.76
Disc	4.11	2.5	4.19	60	4.20
MBP	4.21			100	4.14
				140	4.29
5% lsd	0.06		**0.05**		0.07

pHCaCl2						
Depth (cm)	Control	DP	MBP	Lime	MBP + Lime	DP+Lime
0--5	4.5	4.2	4.8	5.4	4.8	5.3
5--10	4.5	4.4	4.7	4.8	5.2	5.1
10--20			4.8		5.4	

Cultivation	Lime (t/ha)	Fertiliser (kg/ha) 20	60	100	140
Control	0	3.79	3.76	3.81	4.05
	2.5	3.64	4.28	4.20	4.28
Disc Plough	0	3.67	4.12	4.15	4.29
	2.5	3.90	4.24	4.26	4.21
MBP	0	3.97	4.19	3.93	4.38
	2.5	3.61	4.60	4.51	4.54
5% lsd					0.16

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- The use of a mouldboard plough while eliminating or reducing non-wetting created sometimes other not yet fully understood problems.

- Lifting the soil pH to above 4.8 in combination with soil cultivation (DP/MBP) and fertiliser maximised the yield.

A big thank you to Tim and Ray Harrington, Bruce Taylor, Kellie Shields, Paul Hislop, Justin Elliot, Ben Hobley, Ben Sprigg, Nick Taylor, and Clint Willis, for facilitating the trials.

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Questions?

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