

**INVERSION TILLAGE HAD A GREATER LONG-TERM
EFFECT ON GRAIN YIELD THAN PHOSPHORUS AND
POTASSIUM MANAGEMENT ON A WATER-REPELLENT
SAND**

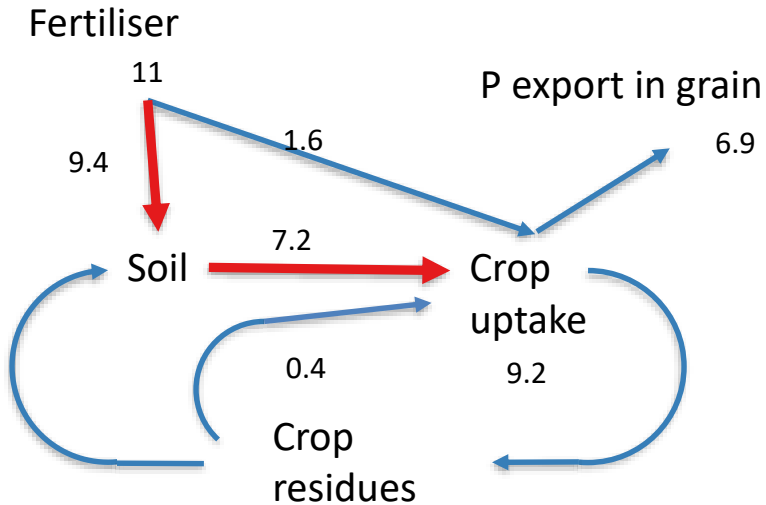
CRAIG SCANLAN, MARIO D'ANTUONO, ROSS BRENNAN AND
GAVIN SARRE, DEPARTMENT OF PRIMARY INDUSTRIES AND
REGIONAL DEVELOPMENT.



GRDC
GRAINS RESEARCH
& DEVELOPMENT
CORPORATION

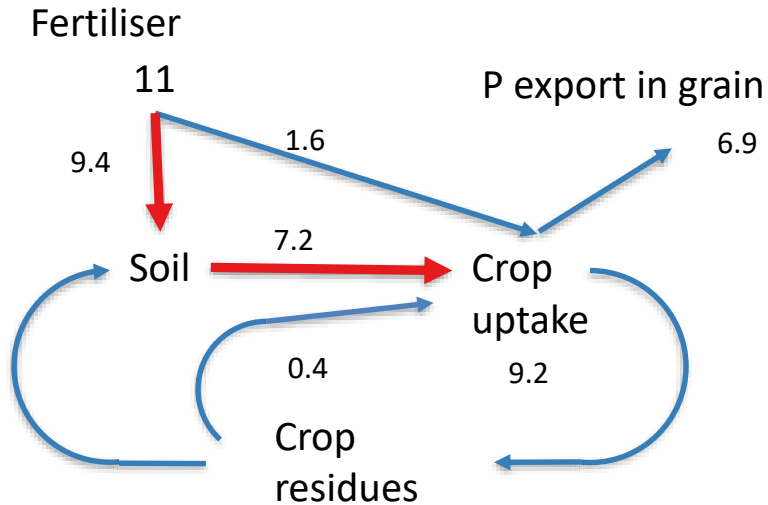
The capacity of a soil to store and supply nutrients is important for the residual benefit from fertiliser.

Phosphorus

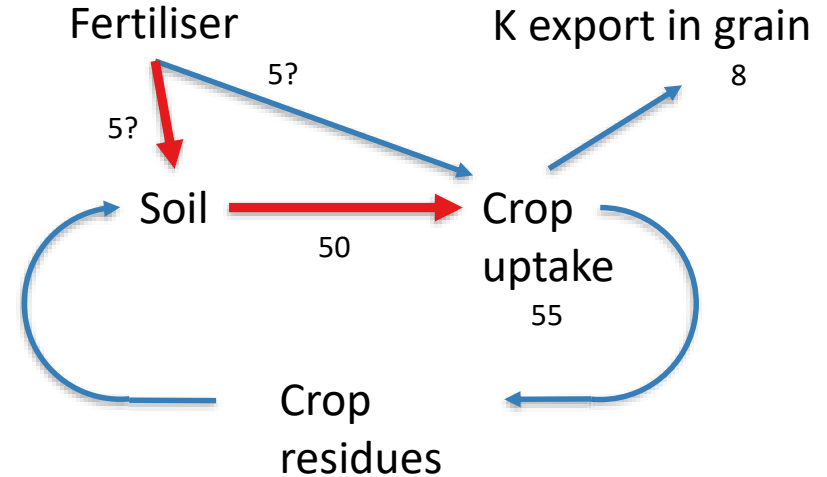


The capacity of a soil to store and supply nutrients is important for the residual benefit from fertiliser.

Phosphorus



Potassium



A design to test for interactions between strategic tillage and nutrient management.

Tillage treatment



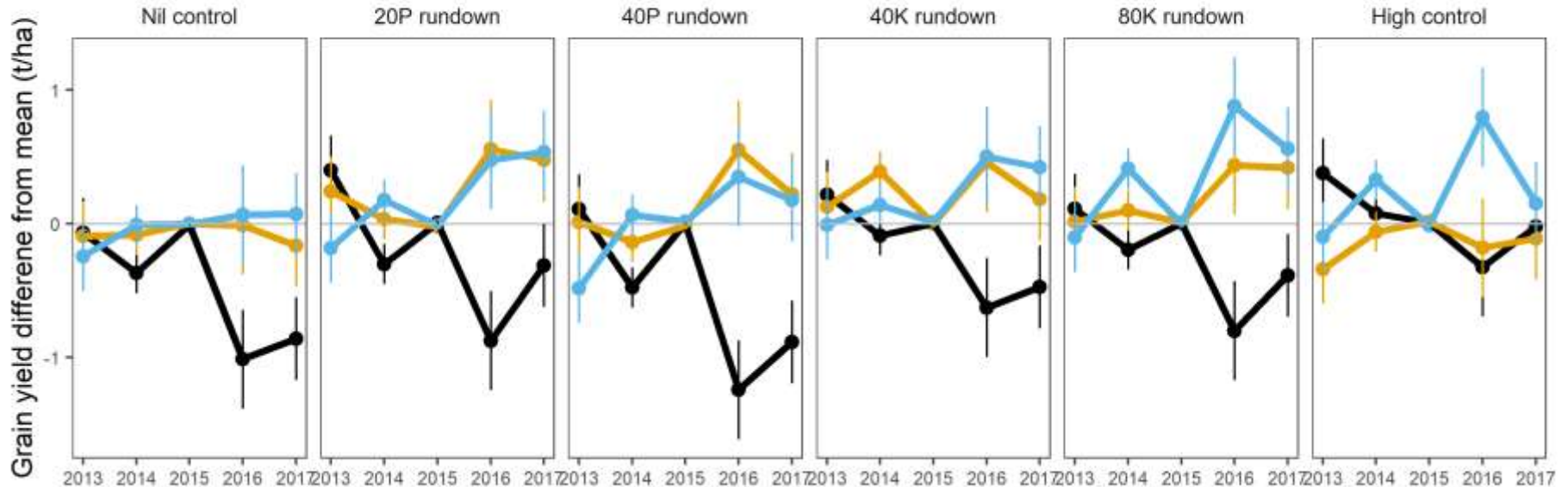
Nutrient treatment

	Tillage operation
No-till control	None
Rotary spader	Deep rip + rotary spader (2013)
Lime + spader	3 t/ha lime + deep rip + rotary spader (2013)

	P applied (kg/ha)	K applied (kg/ha)
Nil control	0 P all years.	0 K all years.
20 P rundown	20 P 2013.	80 K td 2013. 10 K drilled 2014-2017.
40 P rundown	40 P 2013.	80 K td 2013. 10 K drilled 2014-2017.
40 K rundown	20 P all years.	40 K 2013
80 K rundown	20 P all years.	80 K 2013
High control	20 P all years.	80 K td 2013. 10 K drilled 2014-2017.

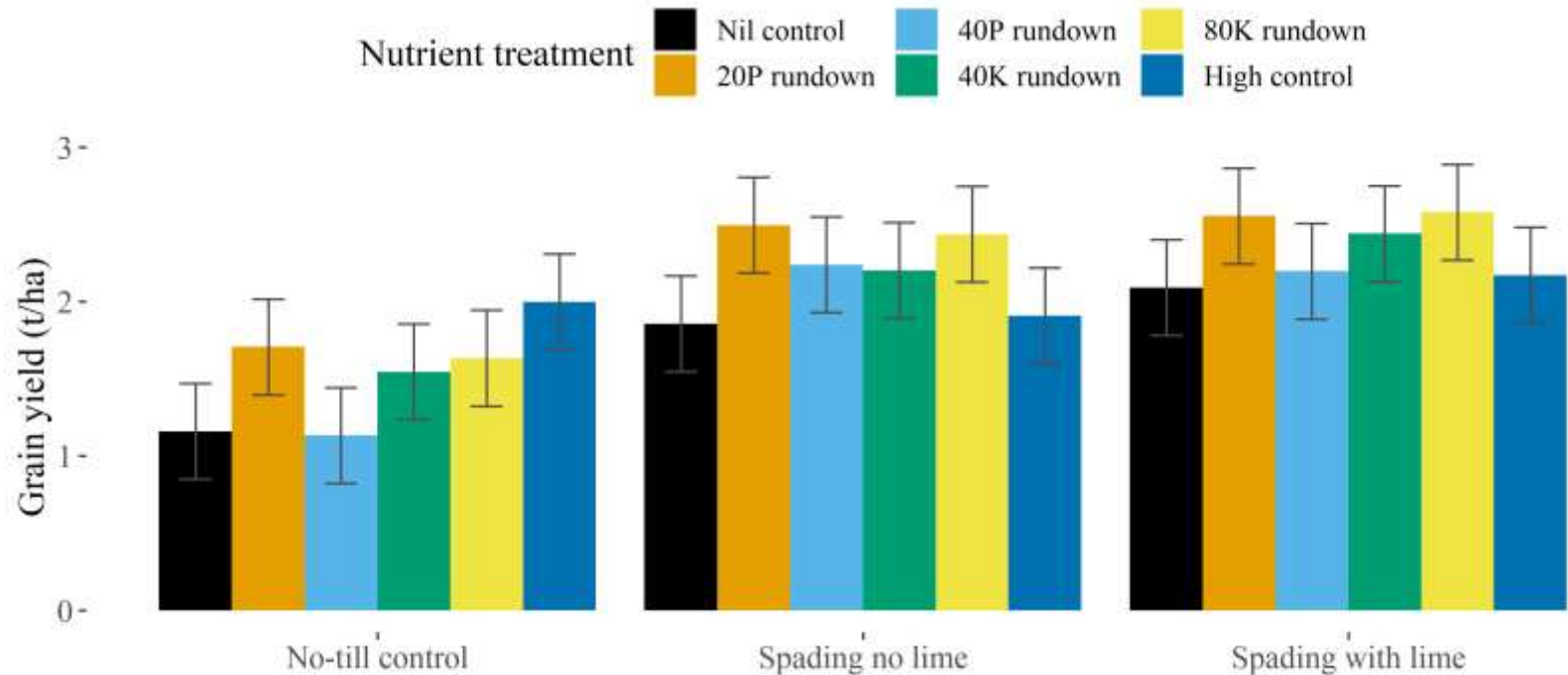
Grain yield for tillage treatments diverged after 4 years.

● No-till control ● Spading no lime ● Spading with lime

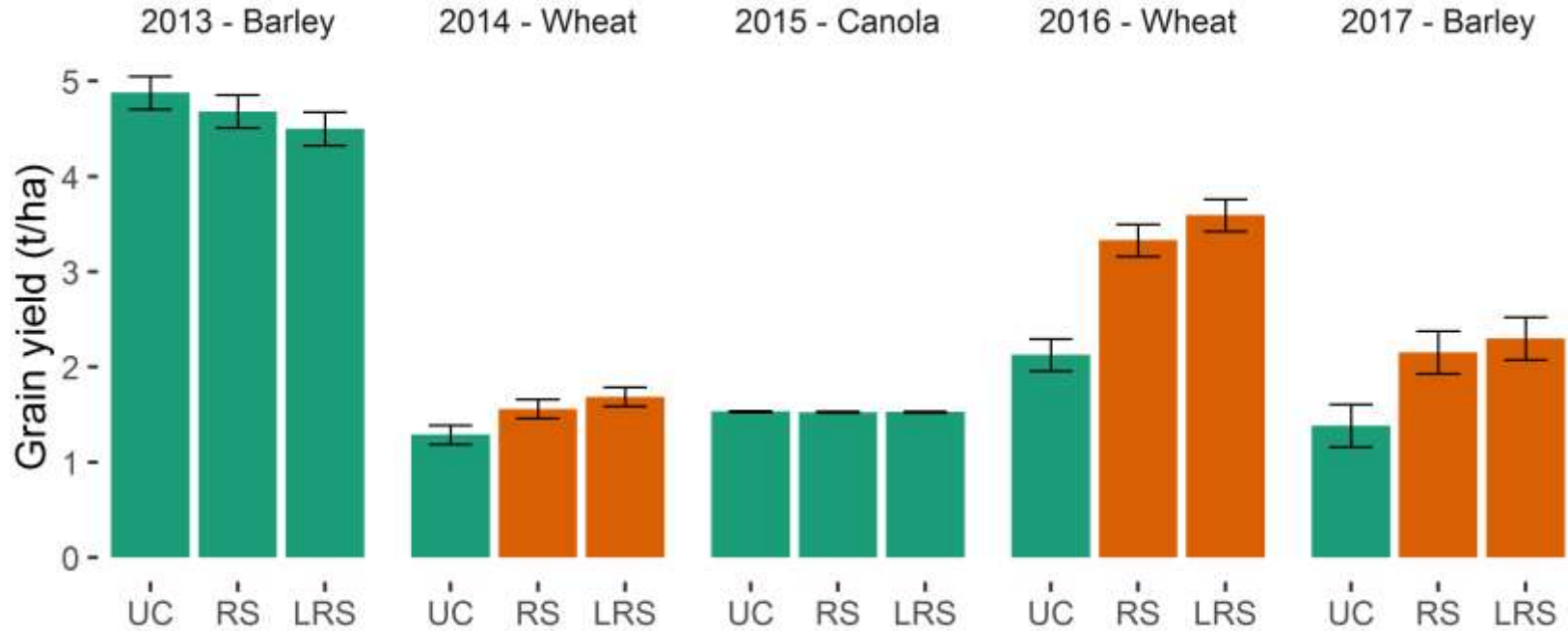


2013 – Barley, 2014 – Wheat, 2015 – Canola, 2016 – Wheat, 2017 – Barley

An interaction between tillage and nutrient treatments occurred in 2017.

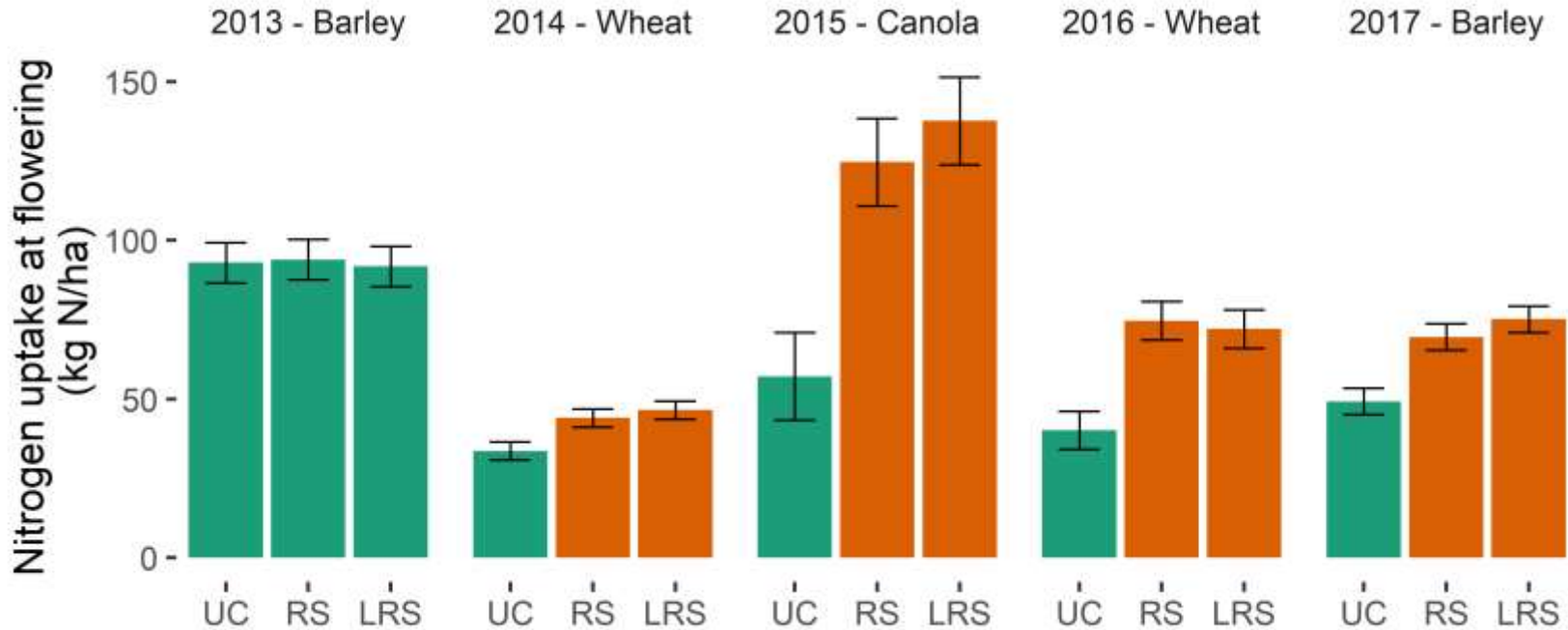


Rotary spading increased grain yield in three of five years.



UC = untreated control, RS = rotary spader, LRS = lime + rotary spader

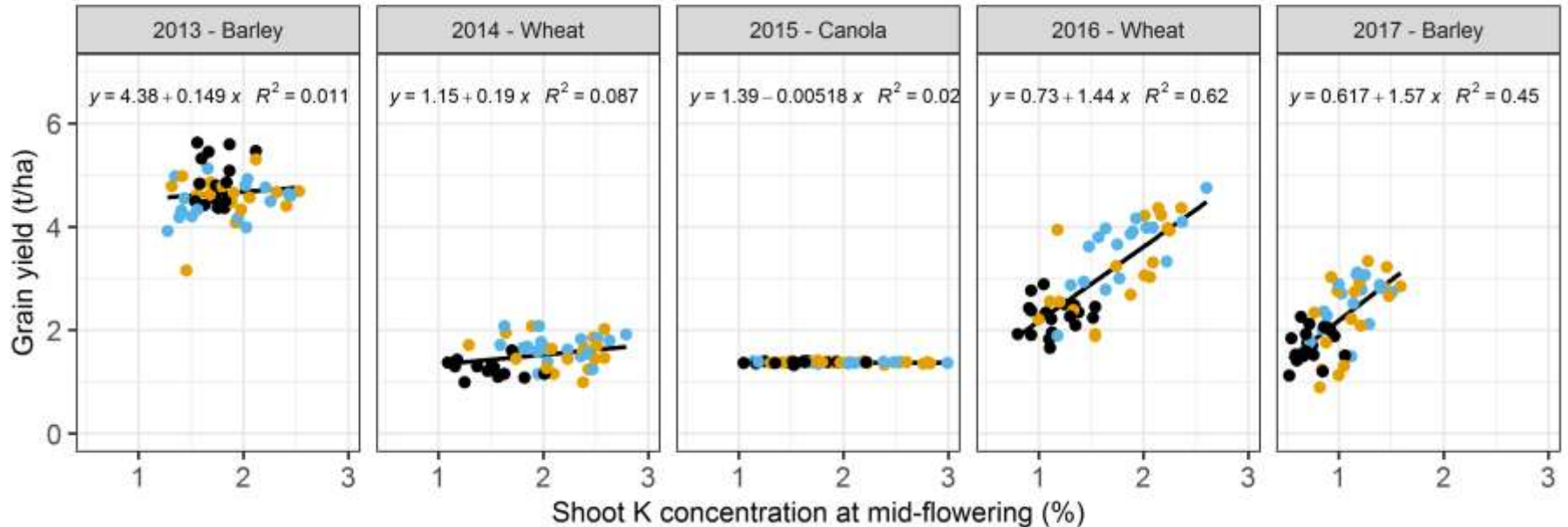
Rotary spading increased N uptake from 2014 onwards.



UC = untreated control, RS = rotary spader, LRS = lime + rotary spader

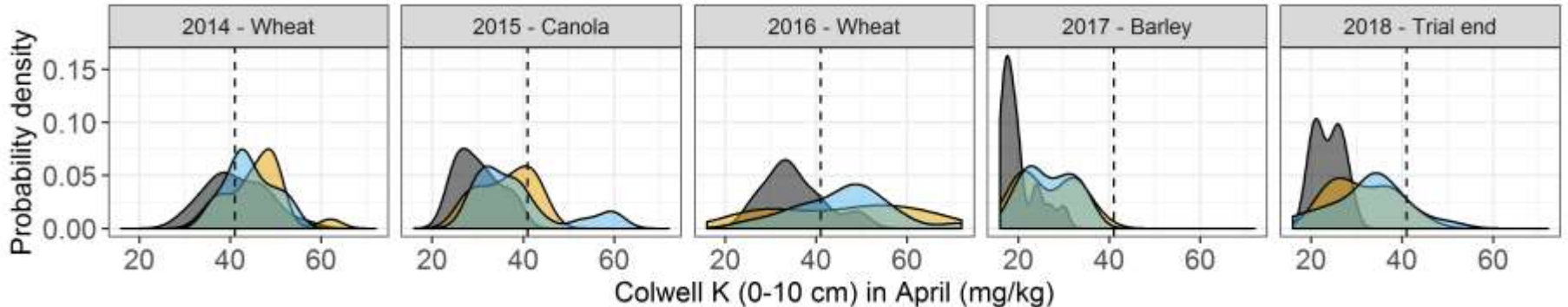
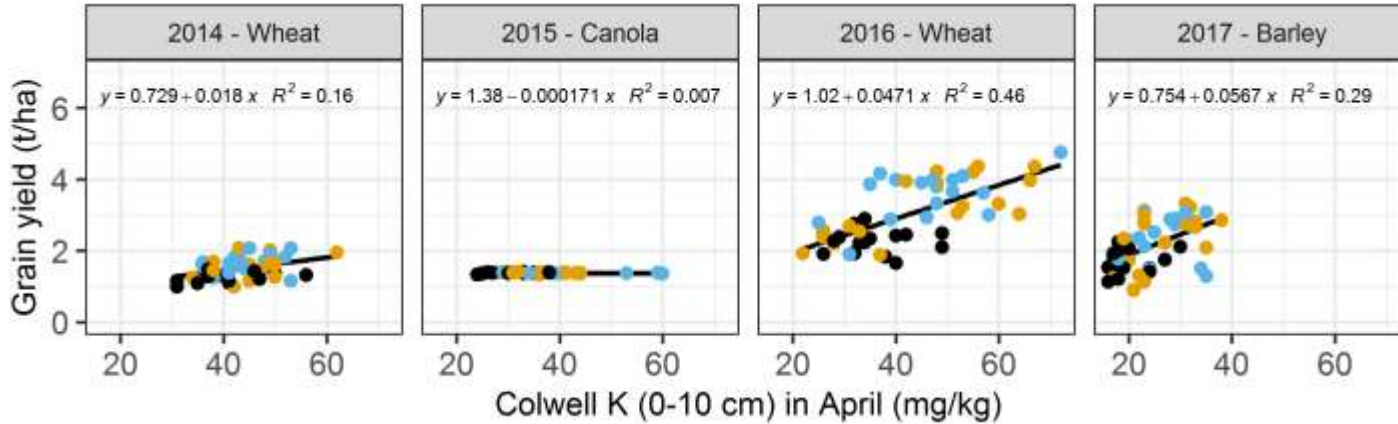
Grain yield response to rotary spading was related to shoot K concentration.

• No-till control • Spading no lime • Spading with lime



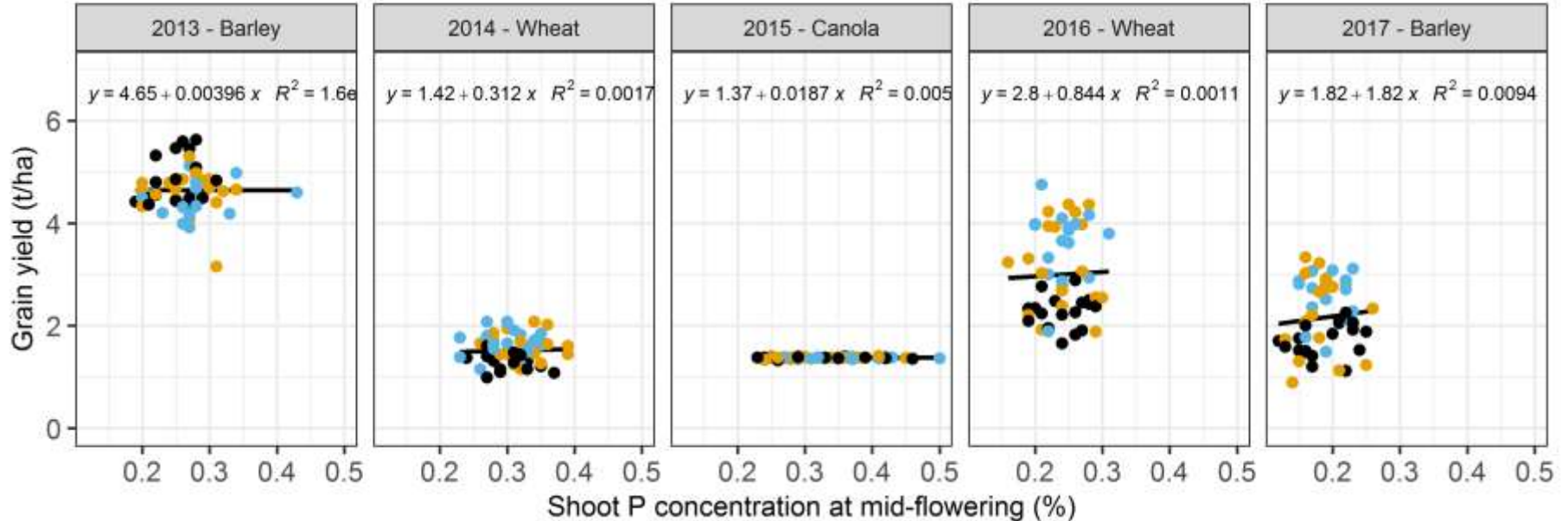
Soil K gradually depleted for all treatments over 5 years.

• No-till control • Spading no lime • Spading with lime

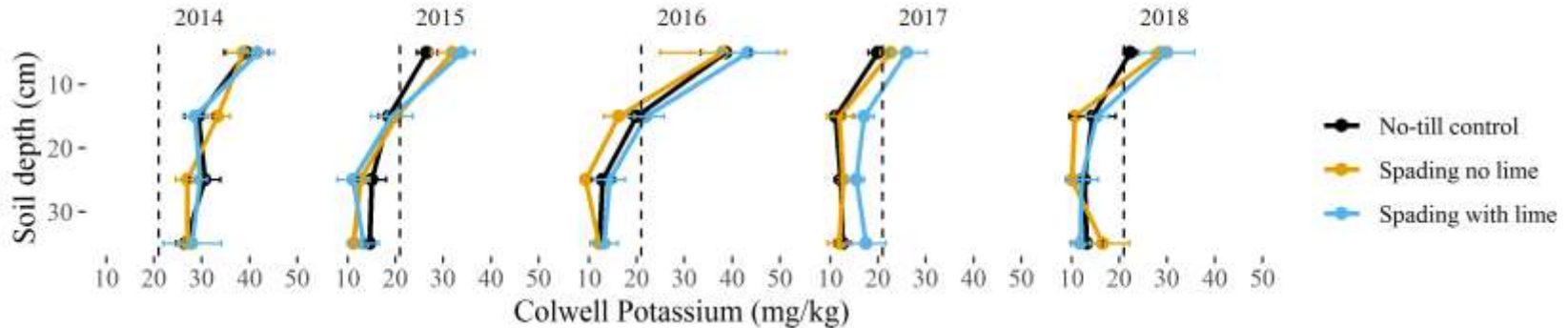
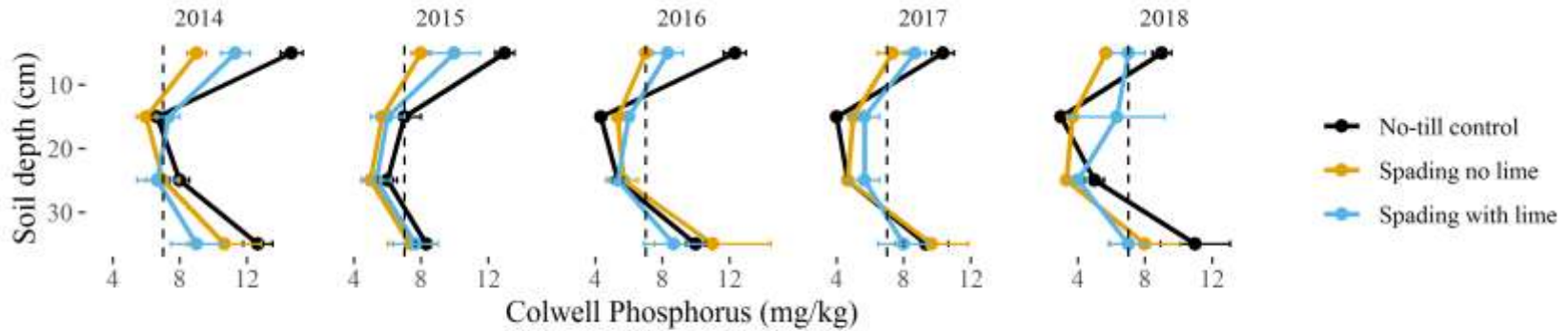


Phosphorus supply at this site was adequate and did not influence yield.

- No-till control
- Spading no lime
- Spading with lime

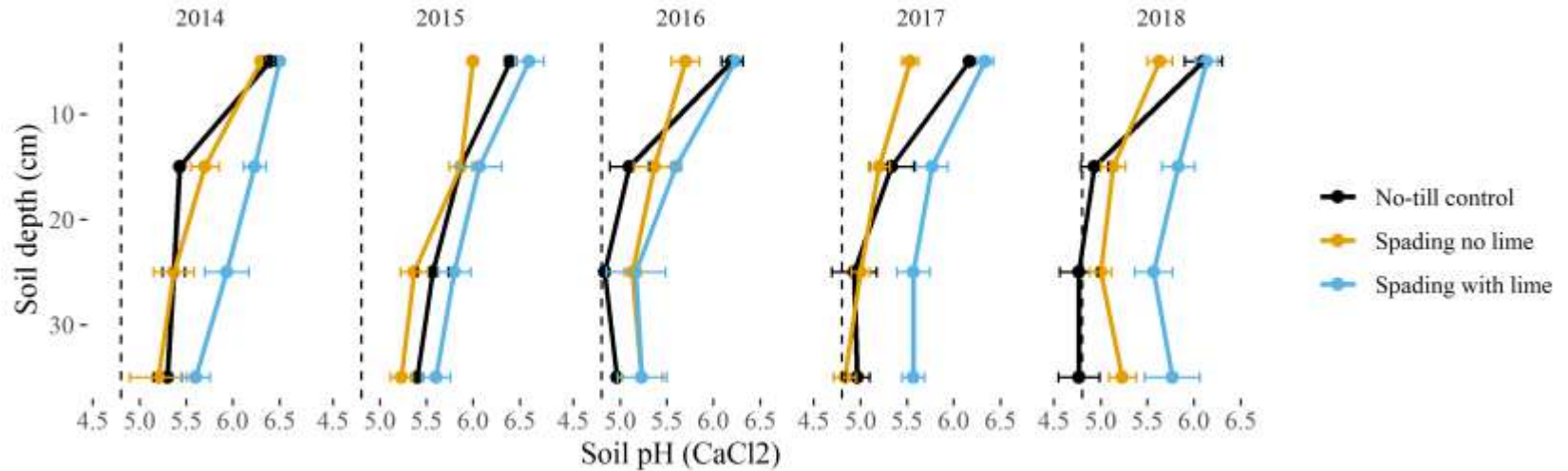


Soil potassium profiles depleted more quickly than phosphorus in the nil treatments.



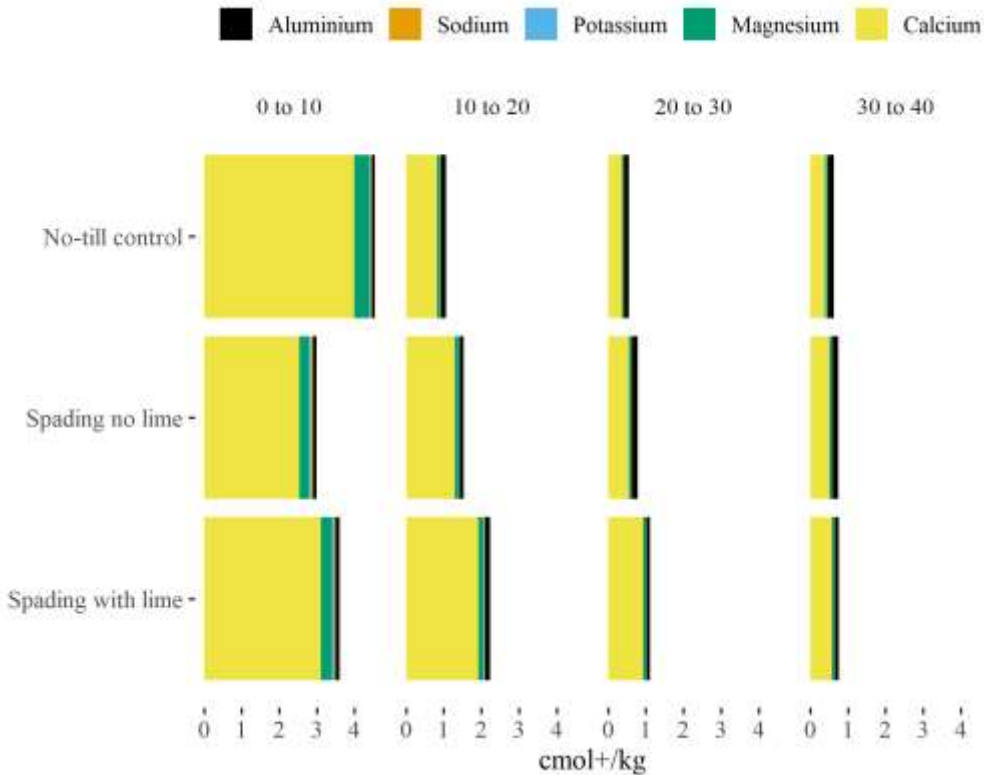
Error bars are standard error

Differences in subsoil pH emerged after 5 years.



Error bars are standard error

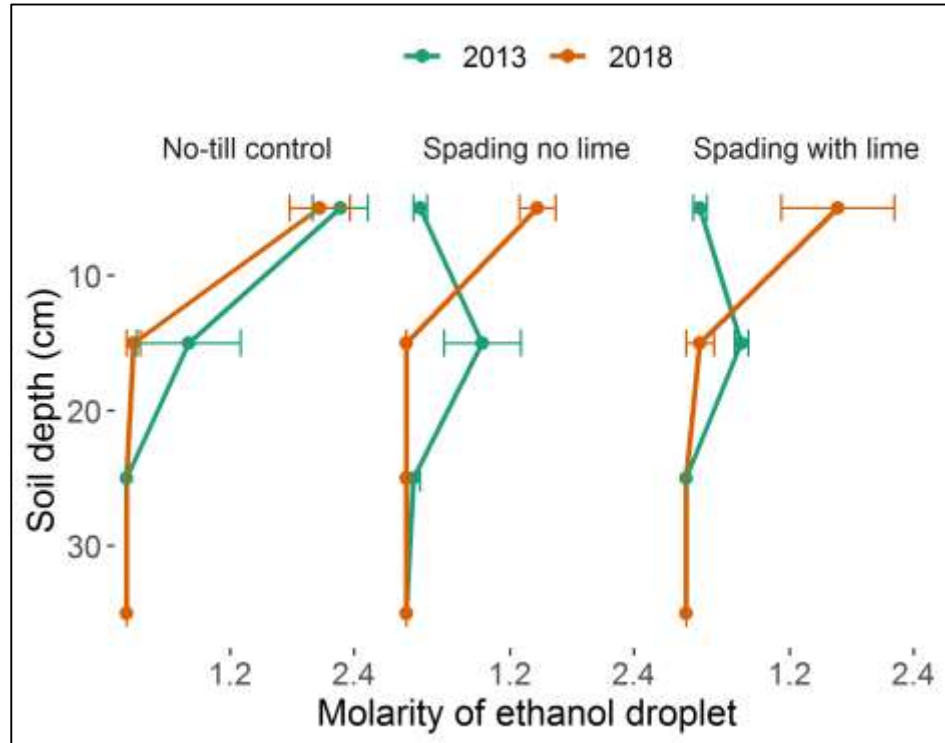
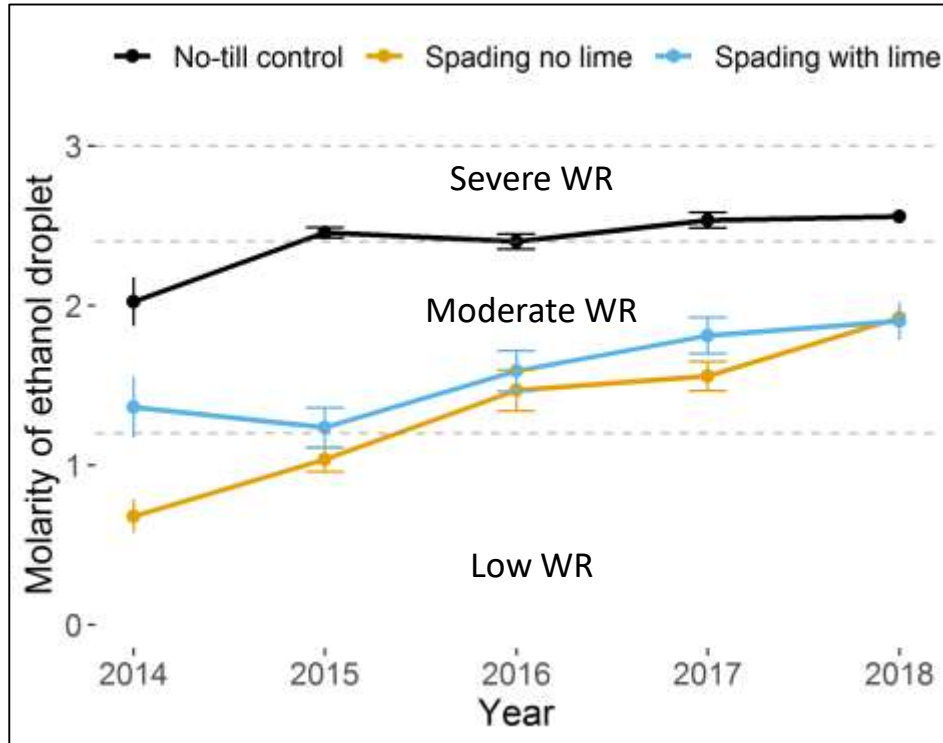
Lime incorporation increased subsoil CEC but didn't change K retention.



Exchangeable K (cmol +/kg) 2018

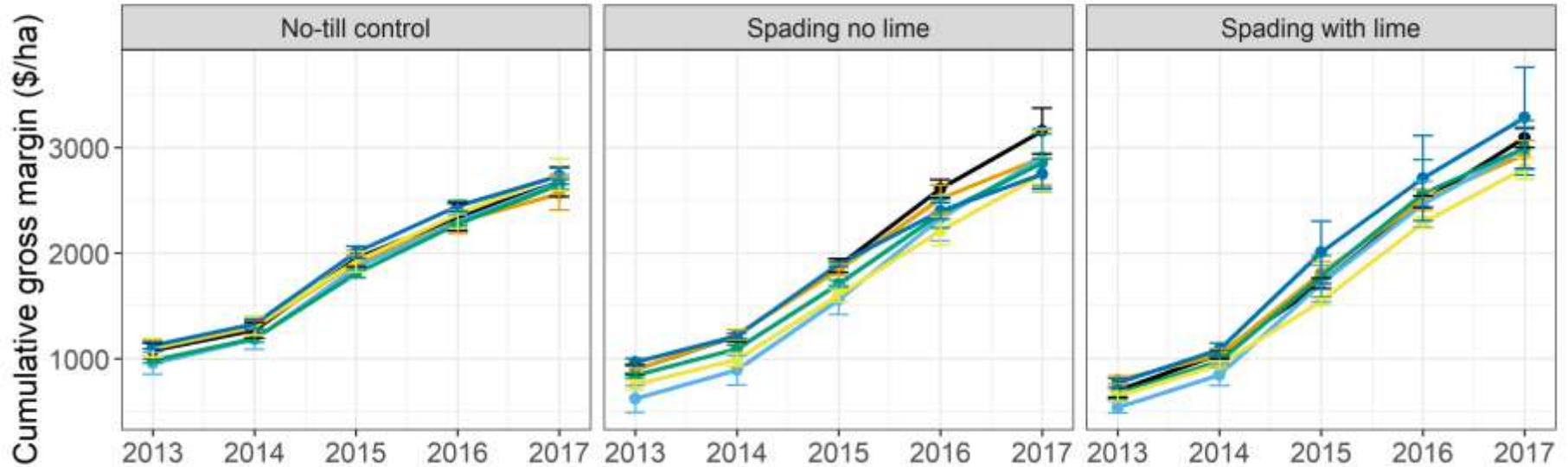
	0 to 10	10 to 20	20 to 30	30 to 40
No-till control	0.04	0.01	0.01	0.02
Spading no lime	0.06	0.02	0.02	0.02
Spading with lime	0.06	0.02	0.01	0.02

Water repellence in the surface layer increased over time, and decreased in the subsurface.



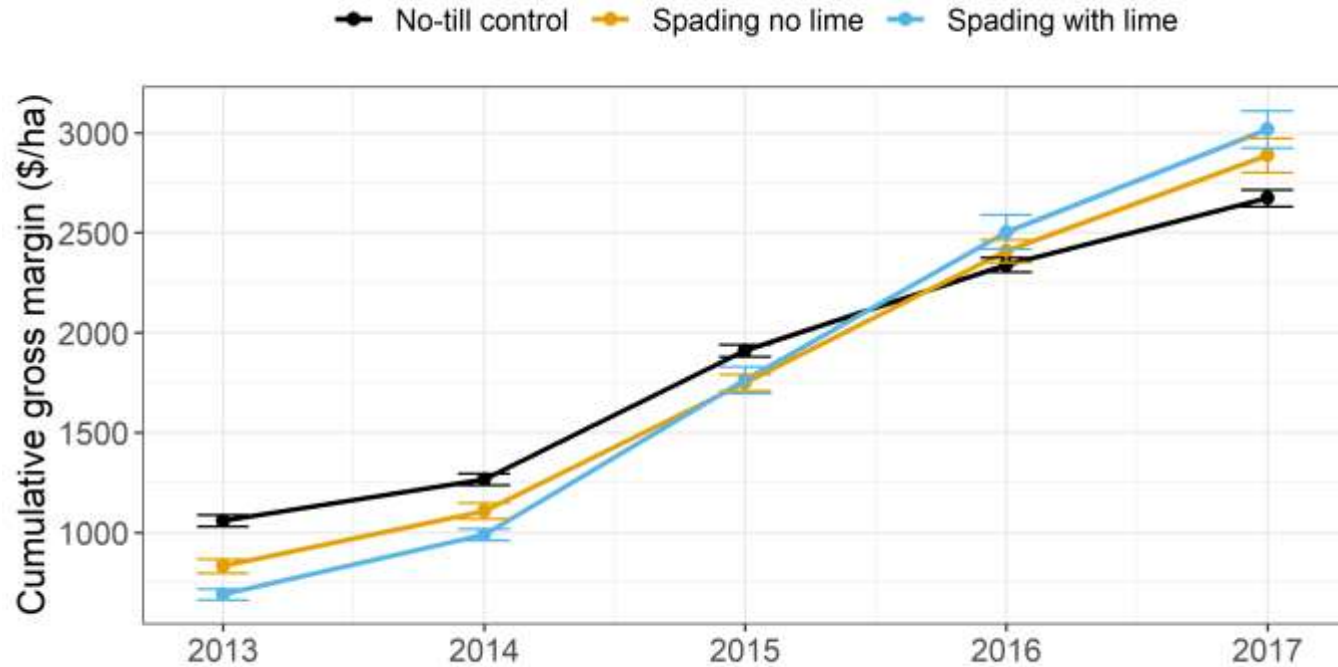
There was no difference in cumulative gross margin between nutrient treatments.

—●— 20P rundown —●— 40P rundown —●— High control
—●— 40K rundown —●— 80K rundown —●— Nil control



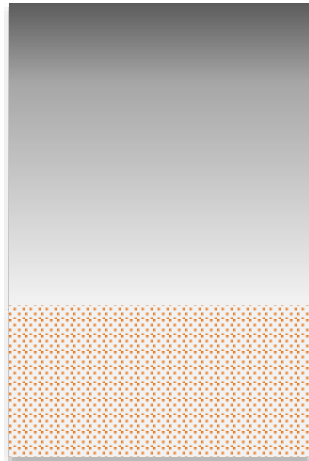
Error bars are standard error

An economic benefit from rotary spading emerged after 5 years.



Error bars are standard error

Soil physical properties remain a constraint to grain yield at this site.



Soil depth (cm)	Bulk density (t m ³)	Gravel (%)	Estimated PAWC (mm)
0-10	1.23 ± 0.04	1	20
10-20	1.44 ± 0.03	1	
20-30	1.54 ± 0.03	2	
30-40	1.59 ± 0.03	10	
40-60	1.94 ± 0.08	40	15

Summary

- Rotary spading had a greater impact on grain yield than nutrient management
- Yield benefit from rotary spading associated with an increase in soil K availability
- Yield response to tillage and nutrient treatments most likely constrained by low PAWC.
- 120 kg K/ha in 5 years did not maintain adequate K supply.
- Incorporating lime did increase CEC, but most likely, not K retention
- Soil water repellence in rotary spading treatments:
 - Surface – a steady increase to moderate levels over 5 years
 - Subsurface – repellence after rotary spading has diminished.

Acknowledgements



Department of
**Primary Industries and
Regional Development**



GRDC Project DAW00222 'More Profit from Crop Nutrition
– Regional soil testing and nutrient guidelines: West'

GRDC Project DAWA-1801 'Nutrient re-distribution and
availability in ameliorated and cultivated soils in the
Western Region'

DPIRD

Steve Cosh
Trevor Bell
Larry Prosser
Daron Malinowski
Amber Balfour-Cunningham

West Midlands Group

Dave Gartner
Dennis Martin
Anne Wilkins
Nathan Craig

Grains Research and Development Corporation (GRDC)

A Suite 5, 2A Brodie Hall Drive, Bentley, WA 6102 Australia

P PO Box 5367 Kingston, ACT 2604 Australia

T +61 8 9230 4600

www.grdc.com.au

 @thegrdc

@GRDCWest

#GRDCUpdates

 @theGRDC

Summary

- Rotary spading had a greater impact on grain yield than nutrient management
- Yield benefit from rotary spading associated with an increase in soil K availability
- Yield response to tillage and nutrient treatments most likely constrained by low PAWC.
- 120 kg K/ha in 5 years did not maintain adequate K supply.
- Incorporating lime did increase CEC, but most likely, not K retention
- Soil water repellence in rotary spading treatments:
 - Surface – a steady increase to moderate levels over 5 years
 - Subsurface – repellence after rotary spading has diminished.

A grey repellent sand with soil nutrients within or above critical ranges.



Depth	Organic carbon (%)	pH (CaCl ₂)	Colwell P (mg/kg)	Colwell K (mg/kg)	Sulphur (mg/kg)	MED	WR rating
0 to 10	1.69	6.4	18	49	12	3.2	Very severe
10 to 20	0.66	5.8	9	35	9		
20 to 30	0.35	5.6	8	29	5		
30 to 40	0.25	5.5	12	25	3		
Critical range (90%)			16 to 25 (0 to 10 cm)	32 to 52 (0 to 10 cm)	2.5 to 3.1 (0 to 30 cm)		

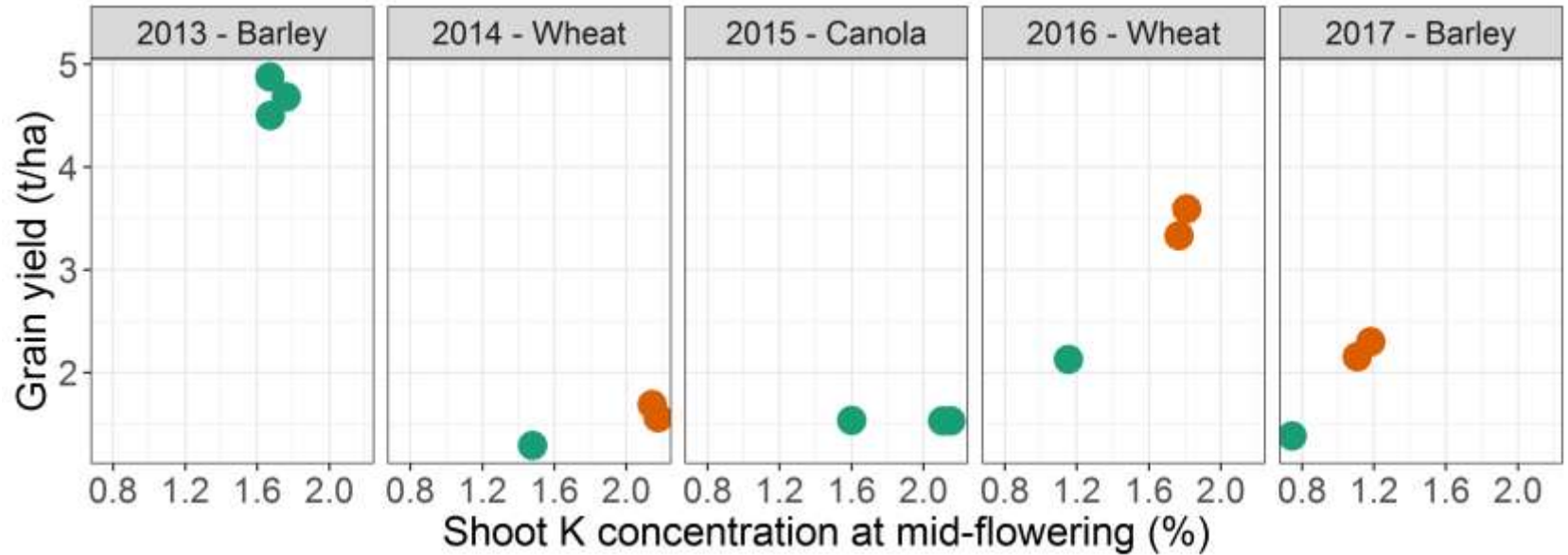
Accumulation of surface residues had a negative effect on crop establishment.



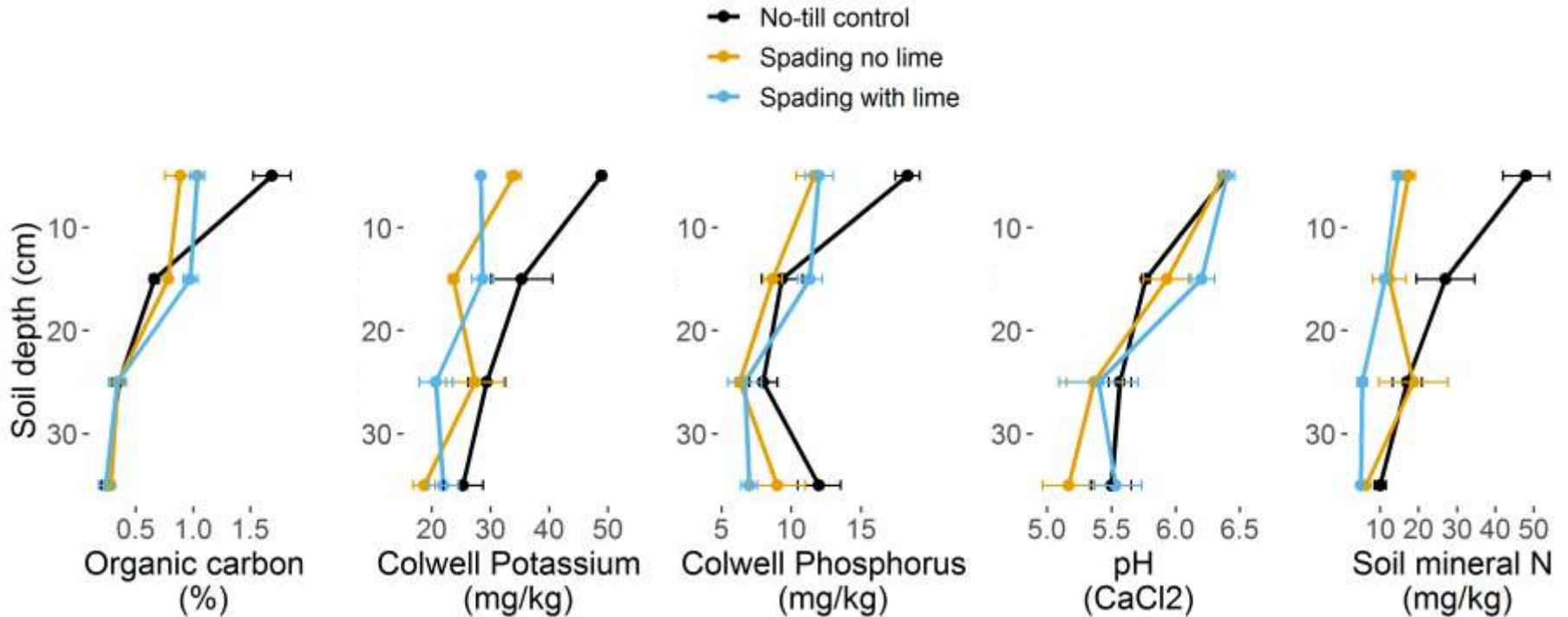
Treatment	Plant density (plants m²)
No-till control	33
Spading no lime	22
Spading with lime	23
I.s.d. (5%)	5

11th June, 2014

Grain yield response to rotary spading was related to shoot K concentration.



Changes to soil chemical properties after rotary spading were greatest at the surface.



Relationship between soil OC, CEC and pH for soil samples taken April 2018.

