Slow and Fast-Release Boron Sources in Macronutrient Fertilizers

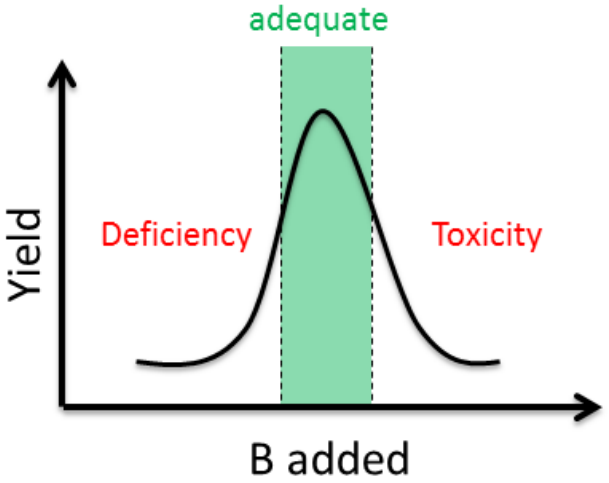
Rodrigo Coqui da Silva, Roslyn Baird, Fien Degryse & Mike McLaughlin

Fertilizer Technology Research Centre

Introduction

Introduction

Among the micronutrients, boron (B) presents the narrowest window between deficiency and toxicity.



This nutrient is usually applied in NPK bulk blends; however it has been shown ineffective because of the uneven distribution.

Bulk blend

NPK B

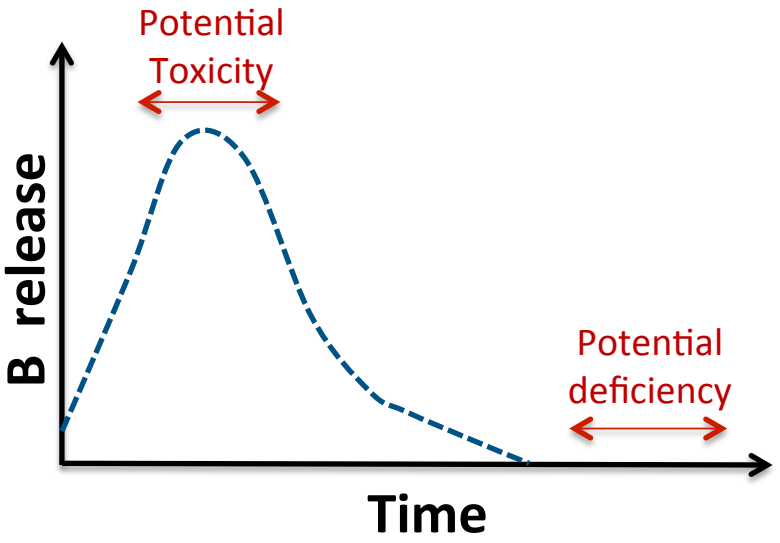
Compound

NPK+ B

Introduction

Challenge: providing B during all plant growth stages as this micronutrient plays important roles from seedling to flowering.

B sources: the most common are highly water soluble and leaching losses may happen because of the weak retention of B in most soils.



Introduction

Ideas to address these issues:

- NPK formulation as carrier.
- Better synchronism between crop demands and nutrient supply using slow (Ca-based) and fast (Na-based) release B sources.

Aim

Produce a range of slow and fast release MOP + B fertilizers, quantifying the nutrient release over time and their effect on canola growth (with and without leaching).

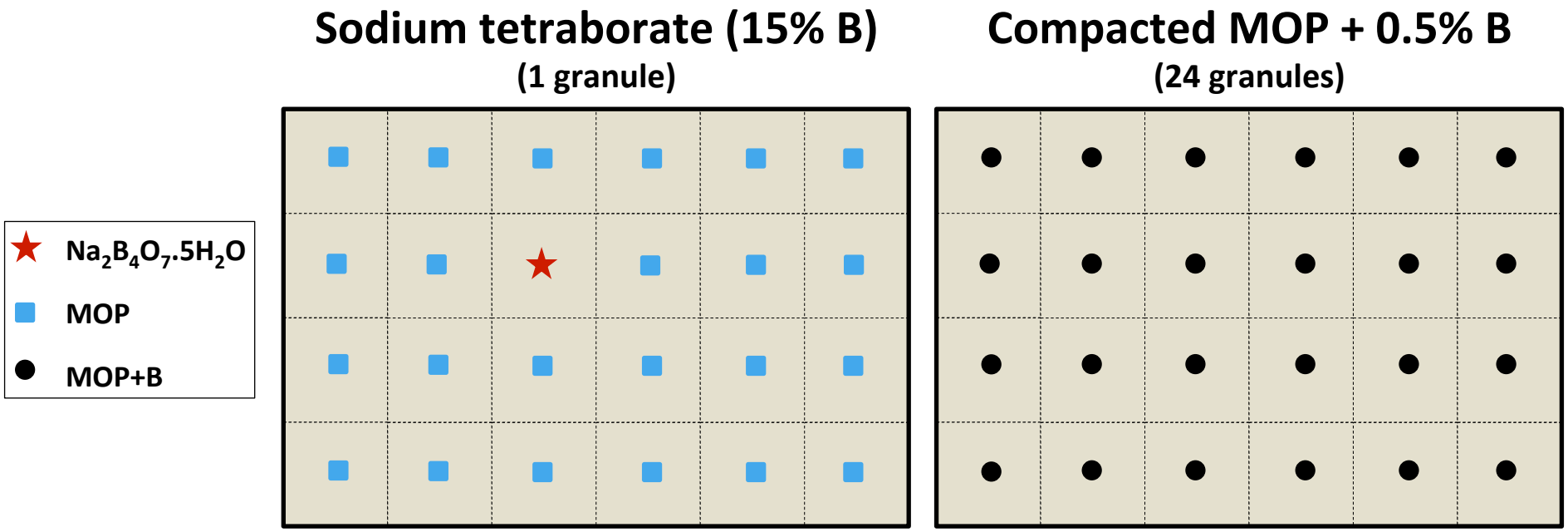
MOP: Muriate of Potash (=KCl)

Methods

Methods

Spatial variability issue

- Trays filled with 4 kg of soil moistened to field capacity.
- Fertilizer application in 5x5 cm cells at rate equivalent to 0.85 kg B/ha.



- Incubation at 25°C (77°F) for up to 9 weeks.
- Soil sampled and B extracted using water (1:5 soil/water ratio, 30 min)

Methods

Fertilizers & Soil

Fertilizer	Ratio B	Acid extractable		Water extractable	
	(%)	K (%)	B (%)	B (%)	B as % total
MOP + Borax	100	45.1	0.57	0.52	**90.0**
MOP + Colemanite	100	46.1	0.53	0.06	**10.8**
MOP + Colemanite : Borax	50 : 50	48.6	0.60	0.29	**49.0**
MOP + Colemanite : Borax	75 : 25	48.5	0.61	0.18	**28.6**
MOP + Ulexite	100	47.0	0.43	0.28	**65.1**
MOP + Ulexite : Borax	50 : 50	46.5	0.59	0.29	**49.2**

Pot trial

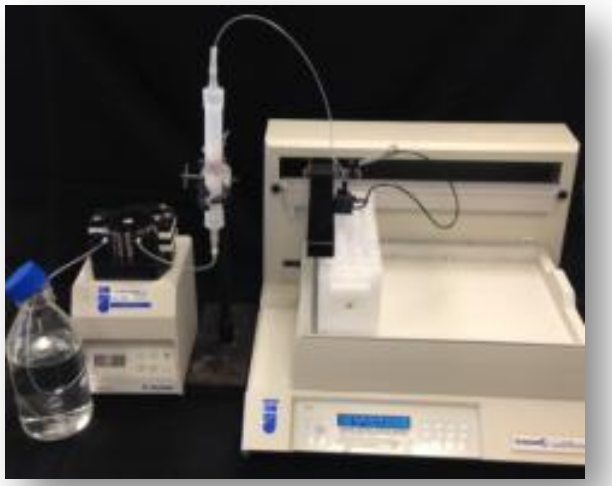
Compaction using pellet press: MOP + borax, ulexite or colemanite.

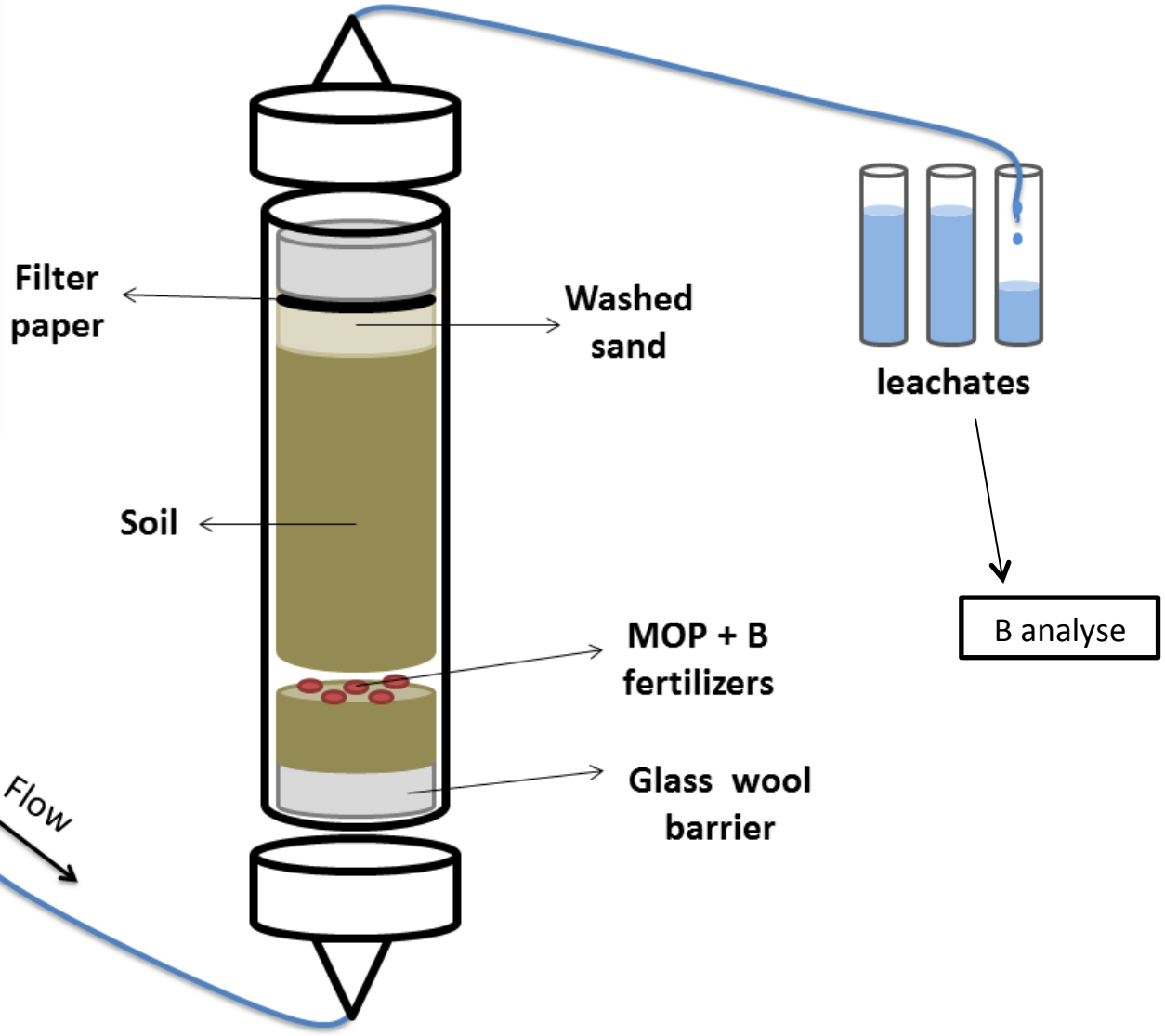
Pellets cut into small pieces: similar weights to commercial fertilizers.

Soil	pH	EC	Clay	CEC	Organic C
	$CaCl_2$	dS/m	%	$cmol_c/kg$	%
Mt Compass	4.9	0.05	4.3	2.0	0.5

Methods

Perfusion cell





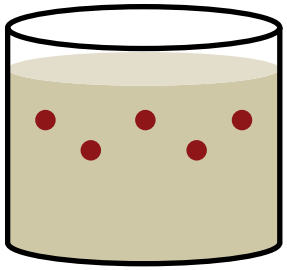
Methods

Pot trial

- Canola as plant test
- **K:** 87 mg/kg; **B:** 0.9 mg/kg
- Balanced basal fertilization
- Five replicates

Leaching after fertilizer application and prior sowing

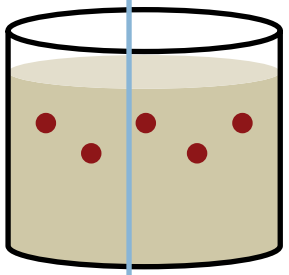
Not leached

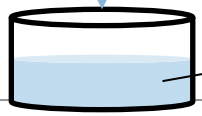


1 kg pots
+
MOP+B

Leached

4 pore volumes





B in the leachate

Results & Discussion

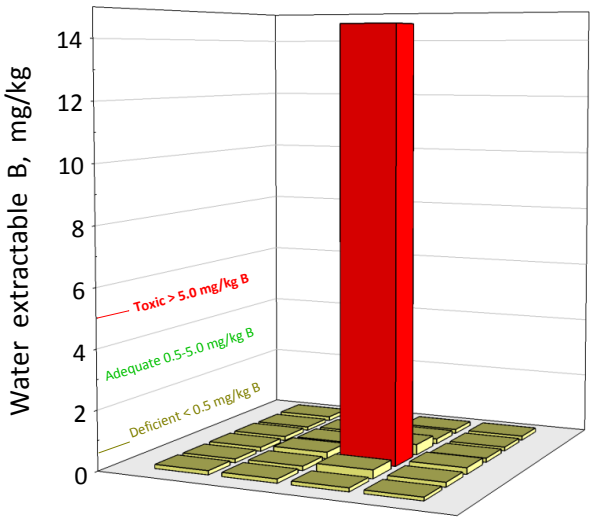
Results & Discussion

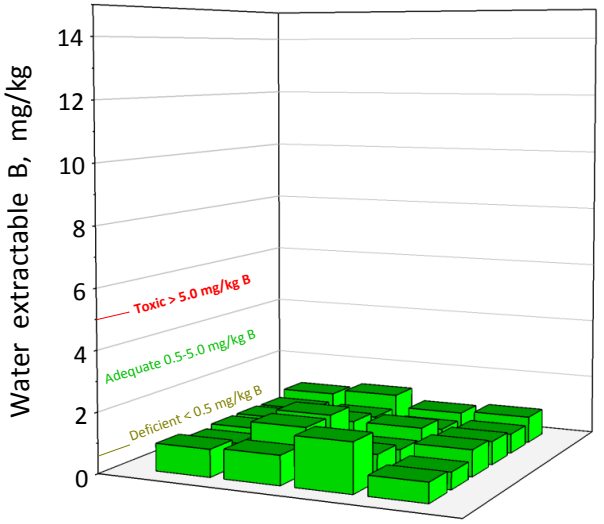
Spatial variability

Sodium tetraborate

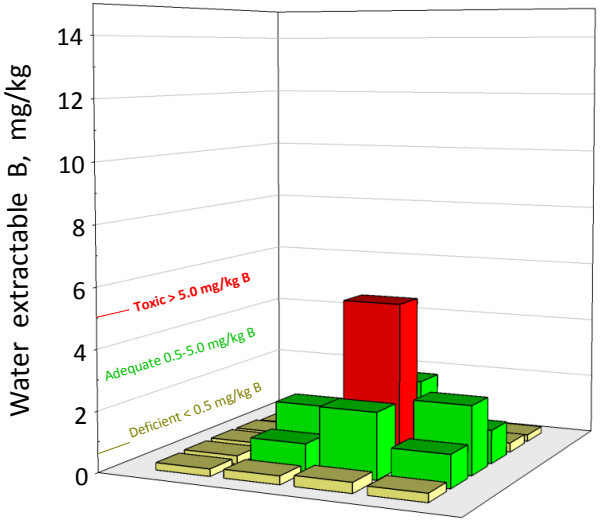
MOP+B

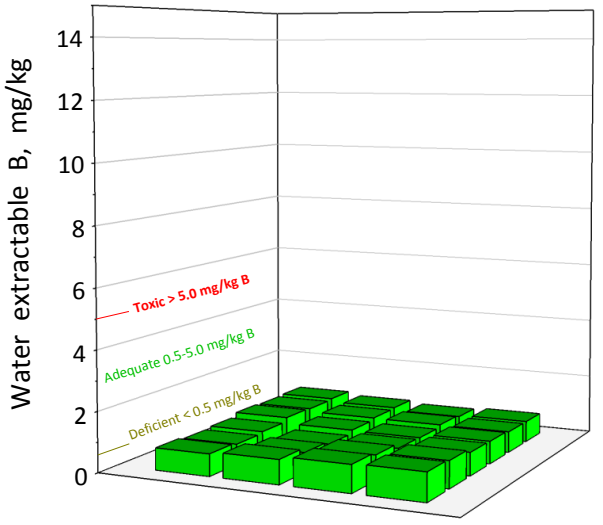
1 week





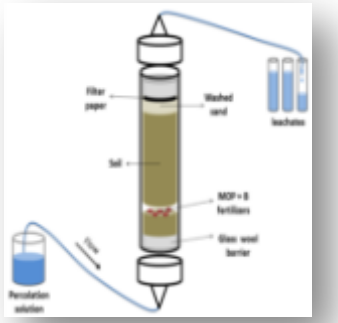
9 weeks

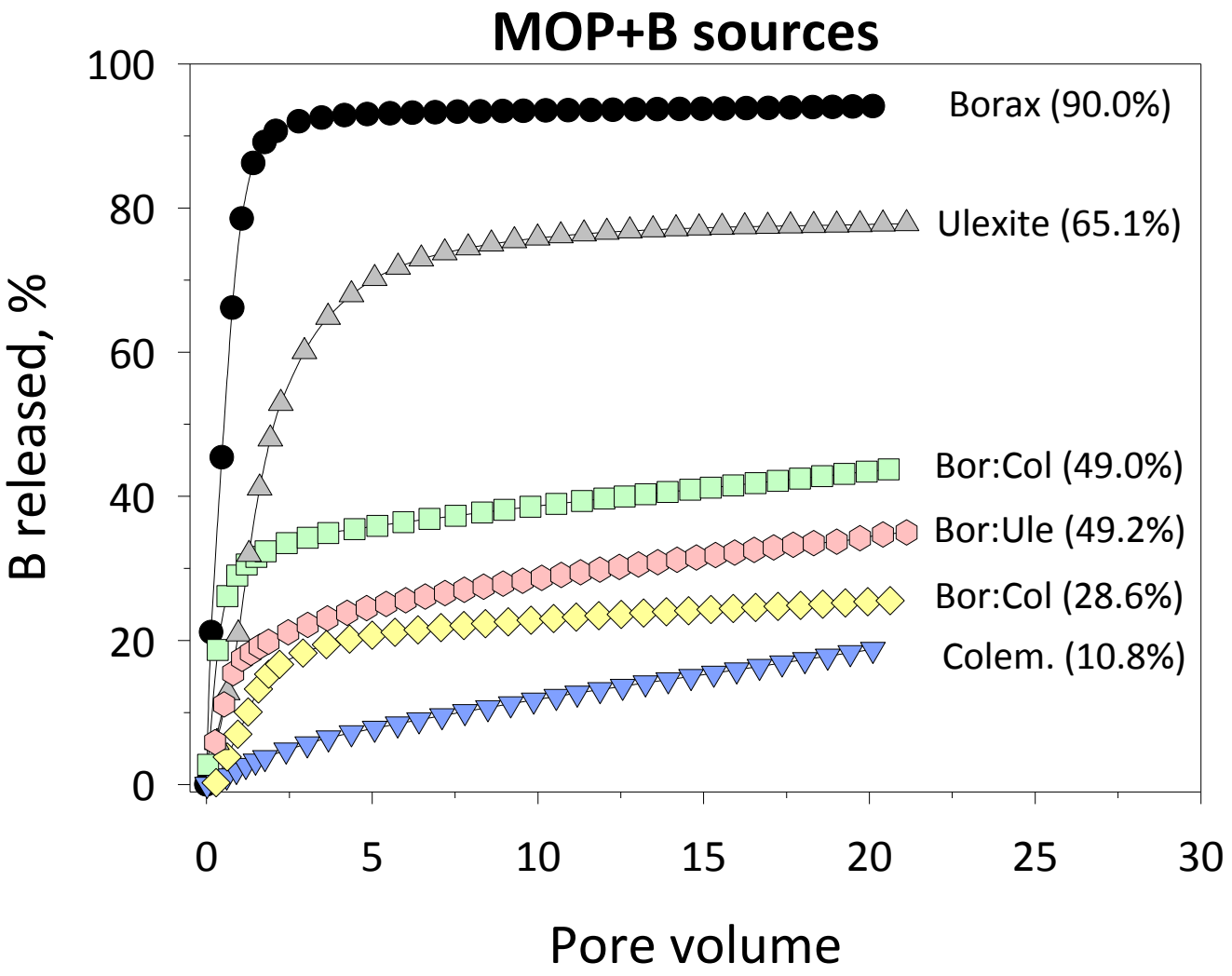




Results & Discussion

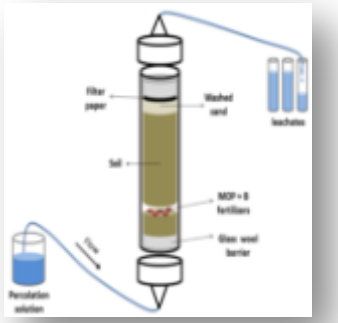
Column leaching

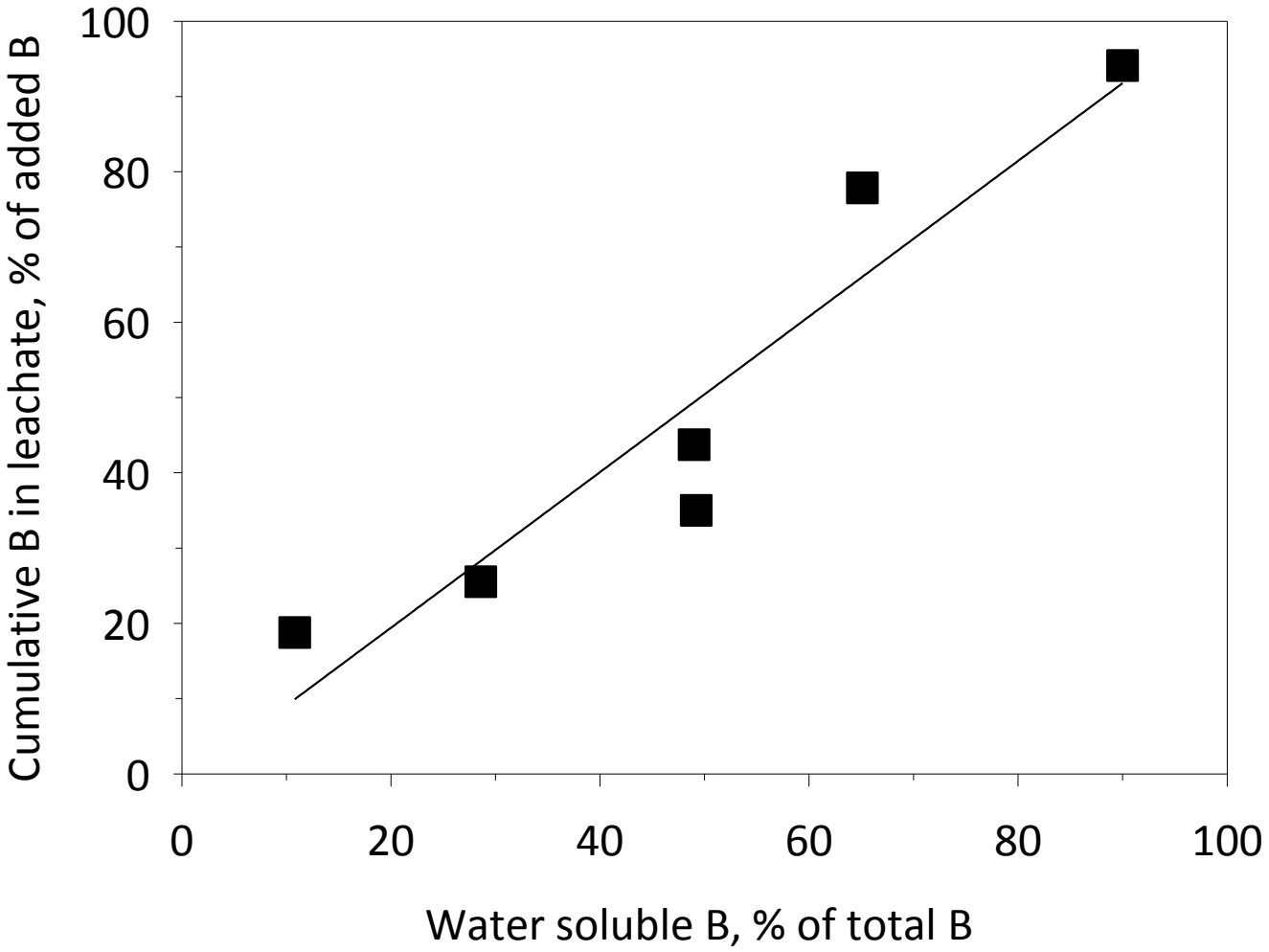




Results & Discussion

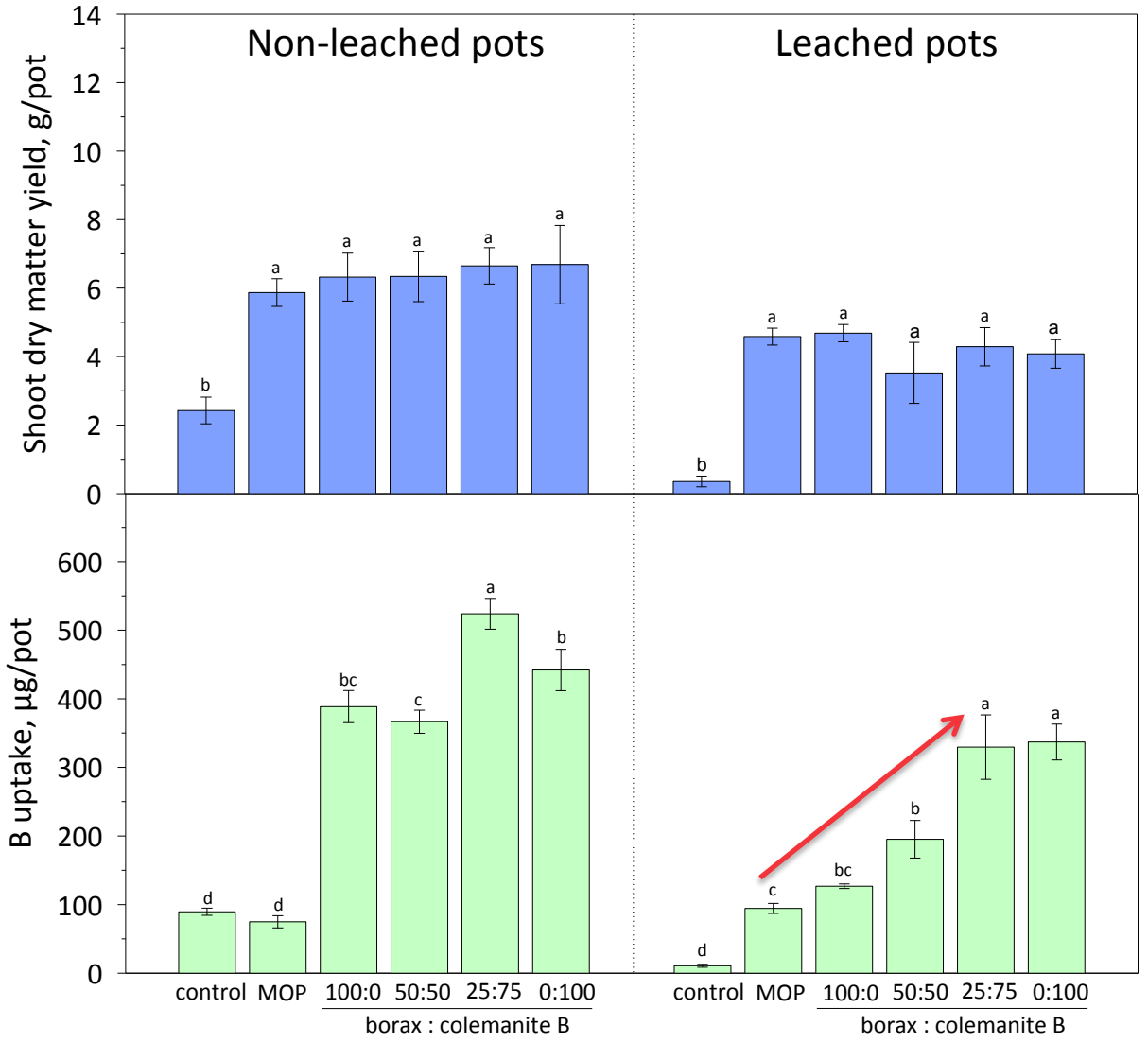
Column leaching





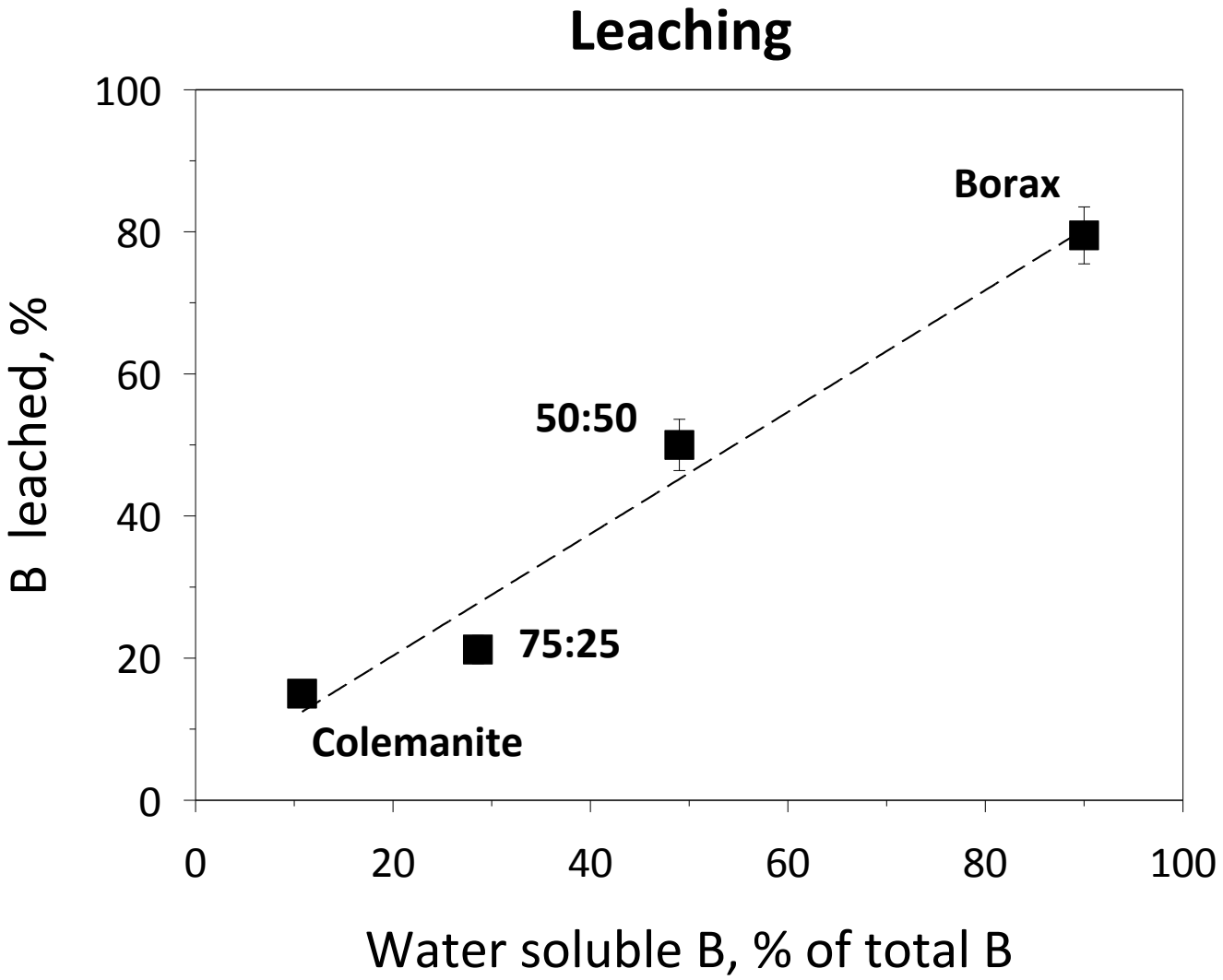
Results & Discussion

Pot trial



Results & Discussion

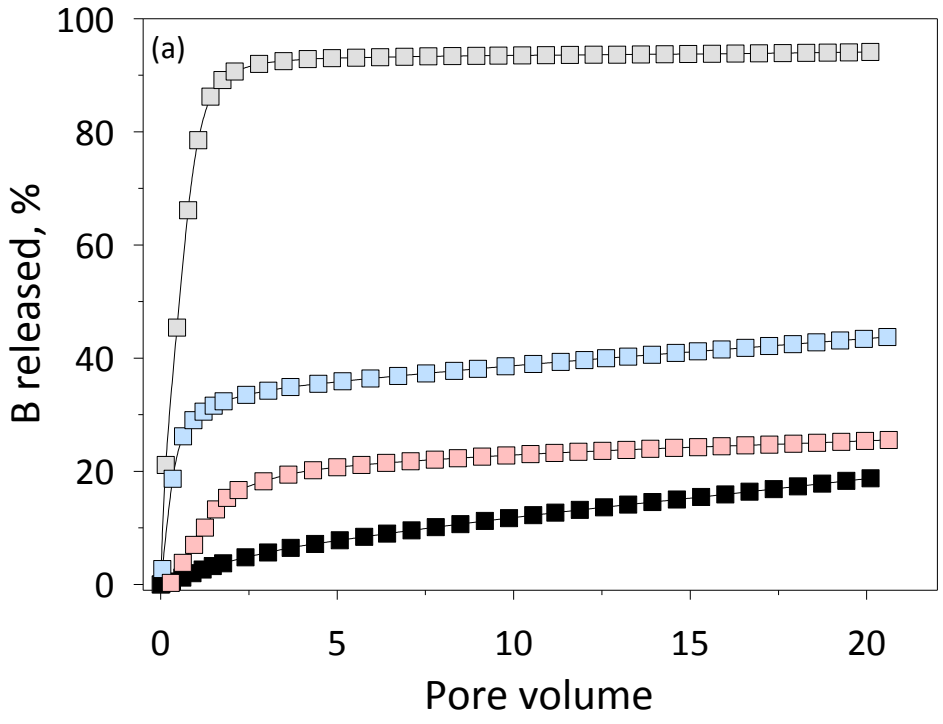
Pot trial



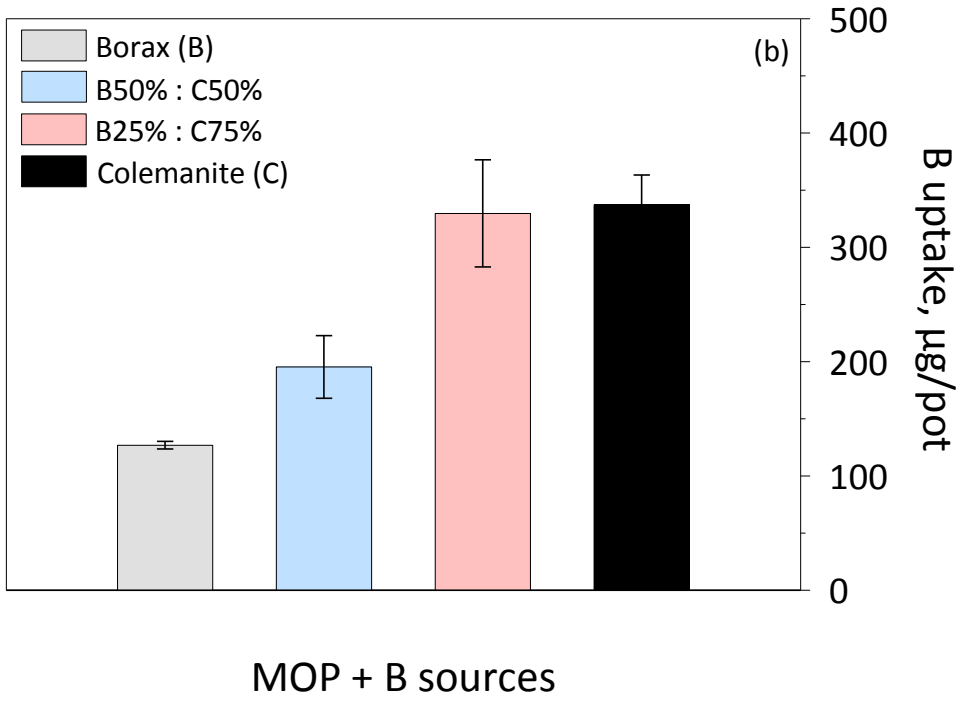
Results & Discussion

Column and pot trials

Column leaching



B uptake



Conclusions

Conclusions

- Compacted MOP+B produces much more homogenous concentrations of B in soils than a bulk blend of MOP + soluble B.

- The use of highly soluble B sources can lead to leaching losses in high rainfall environments (potential B deficiency later in the season).

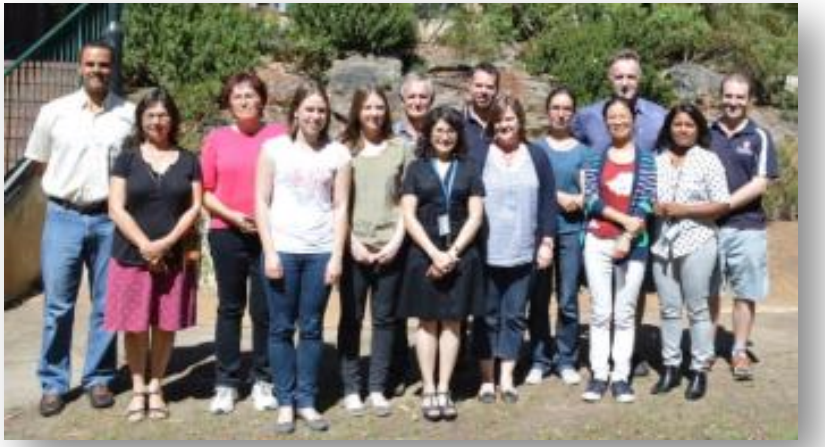
- The results of both column leaching and pot trials support the hypothesis of incorporating a slower release B component into MOP+B formulations to match late crop demands while minimizing losses of B by leaching.

Acknowledgments

Thank you for your attention!

THE UNIVERSITY of ADELAIDE

FERTILISER TECHNOLOGY RESEARCH CENTRE



***Technical assistance*:**

Bogumila Tomczak

Colin Rivers

Ashleigh Broadbent

Mosaic®

US Patent US2013031943-A1

Ferguson D, Olson R, Heinbigner C, (2013)

"Cohered muriate of potash (MOP) product, useful as a fertilizer, comprises micronutrient (e.g. boron, zinc, nickel, iron, and manganese) formed from a compacted MOP composition comprising potassium chloride and micronutrient component".