

Understanding the amelioration processes of the subsoil application of amendments

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NSW GOVERNMENT Department of Primary Industries

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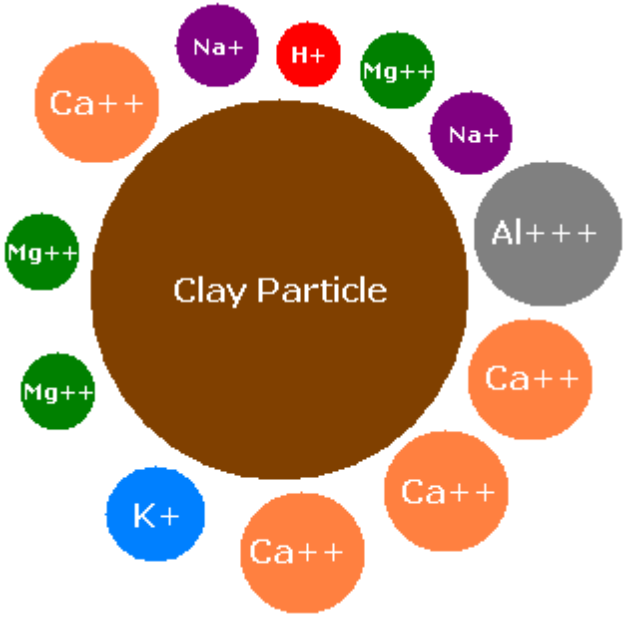
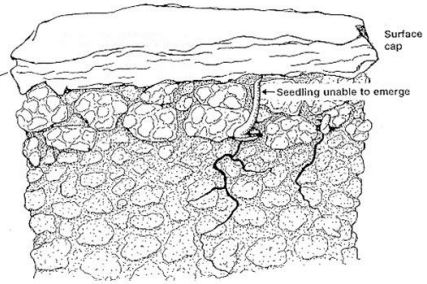
Saline, Sodic, Magnesic or All of the Above?



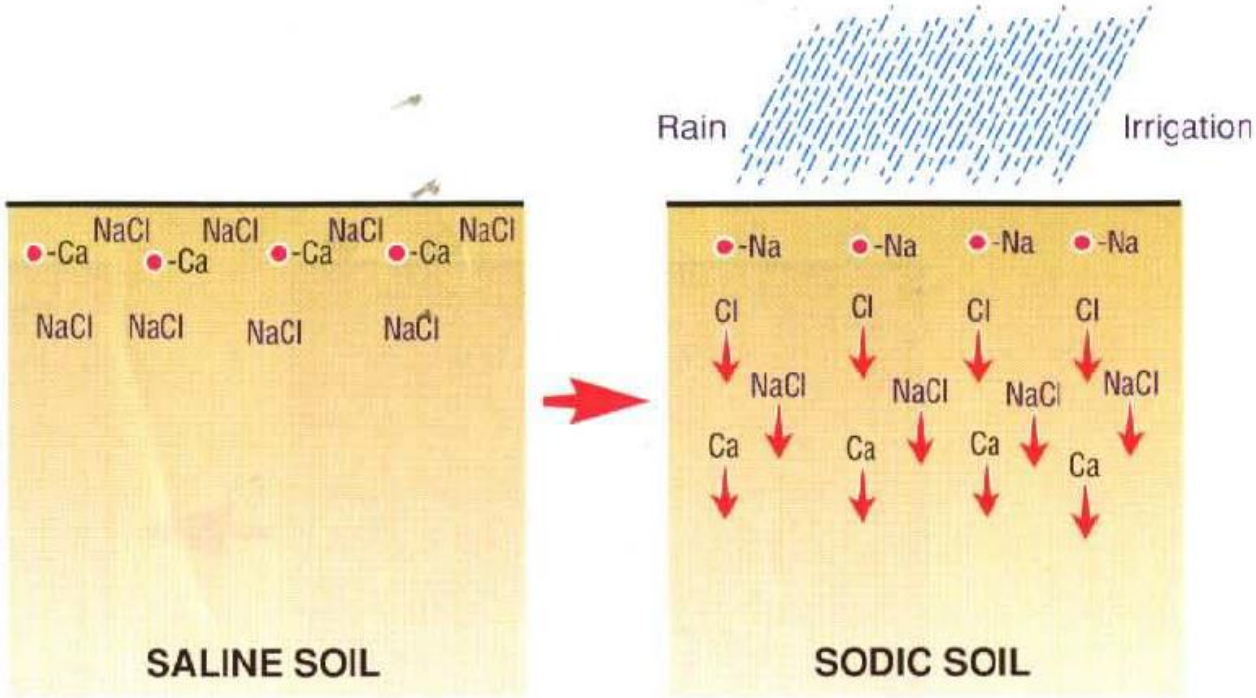
Surface crusting & dispersive soils

Impacts of dispersive clay
- surface crusting impacts on seedling emergence

Fine particles form a crust



How do soils become sodic



Legend

NaCl	Sodium chloride (salt)
Na	Sodium
Cl	Chloride
Ca	Calcium
•	Clay particles

Salts, chloride and calcium are washed down into the soil leaving sodium in the surface layers bound to clay particles.

Transformation of subsoil structure

Control 30-40 cm **Subsoil manure 30-40 cm**

- **Amelioration can transform the subsoil**
- **Potential increase grain yields by up to 70%**

Poor water use efficiency

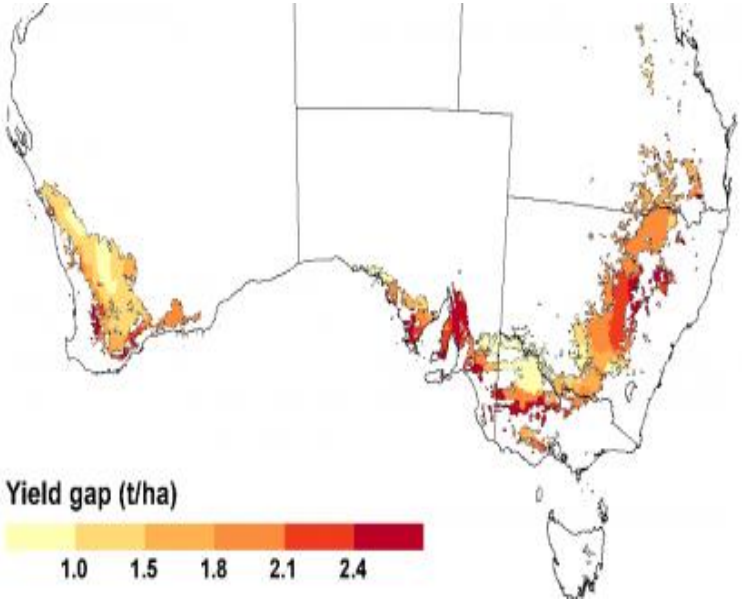
Different environments;
Different Constraints

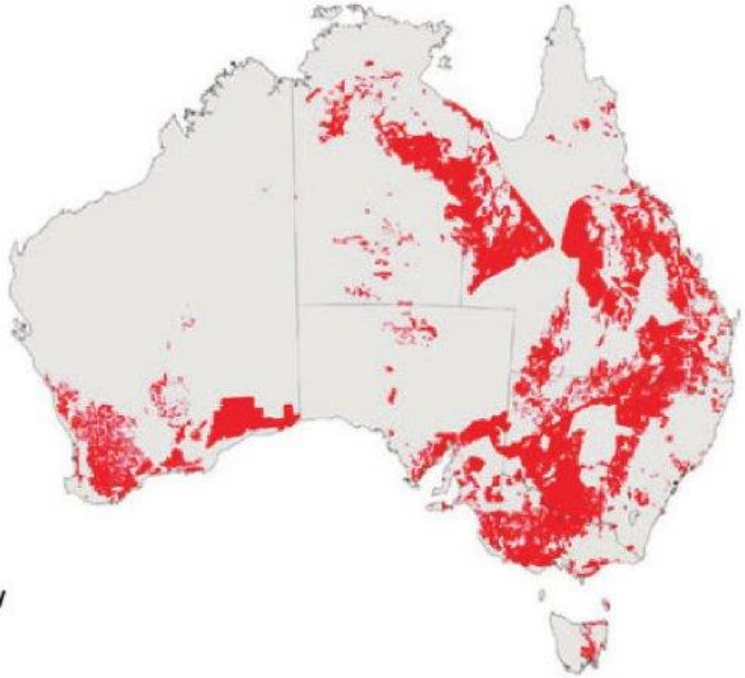
Common problem

Soil physicochemical & nutritional constraints = poor WUE

↓ yields ; reduced profitability ; > offsite impacts

Wheat farm yield and water-limited potential yield





- **Effective use of water stored deep in the soil profile**
- **Management of subsoil constraints**
- **10.5 mm of additional subsoil water = extra 0.62 t/ha**

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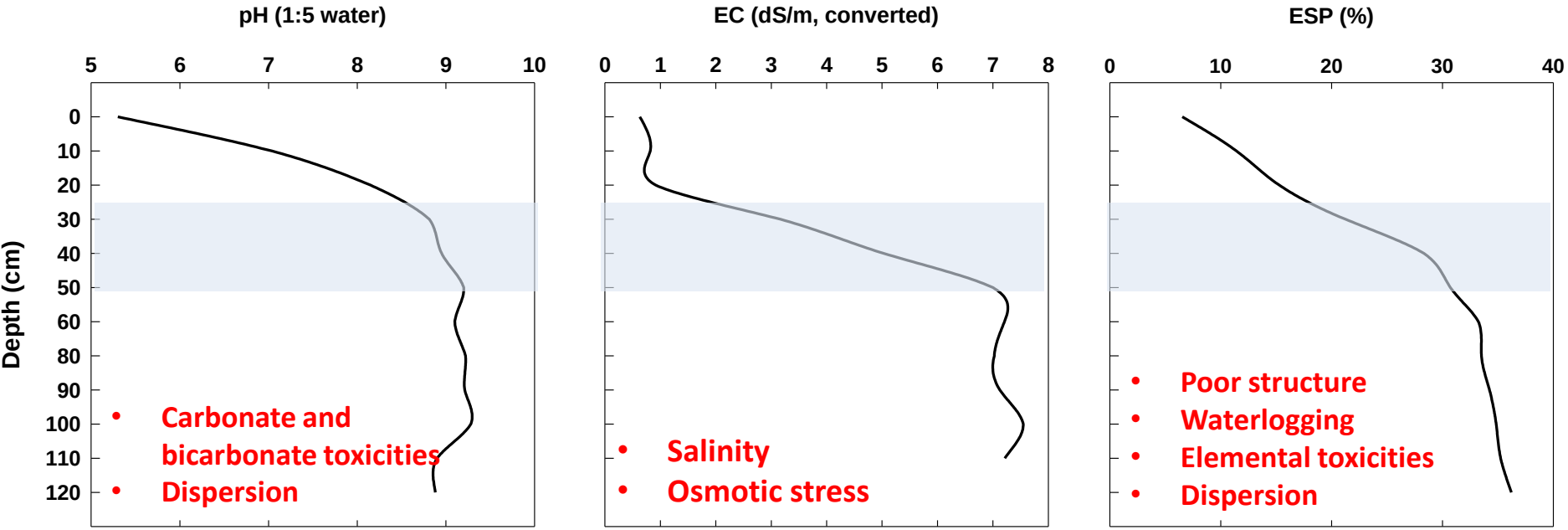
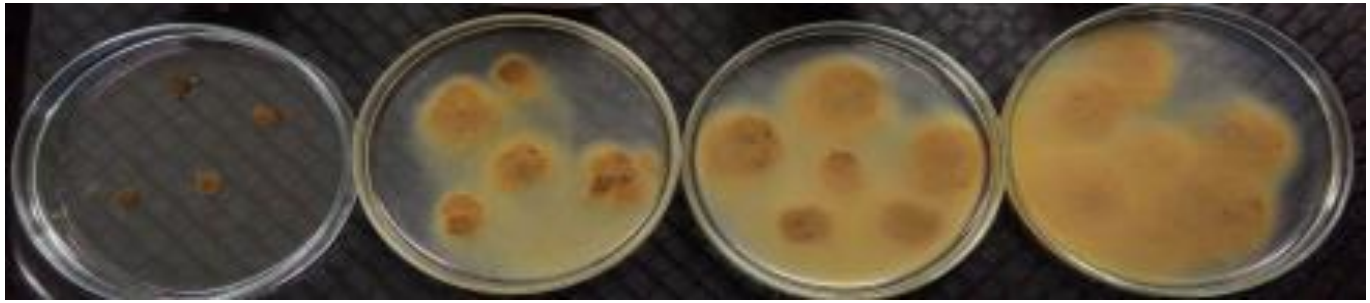
Site characteristics: SNSW





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Amelioration treatments applied in March 2017

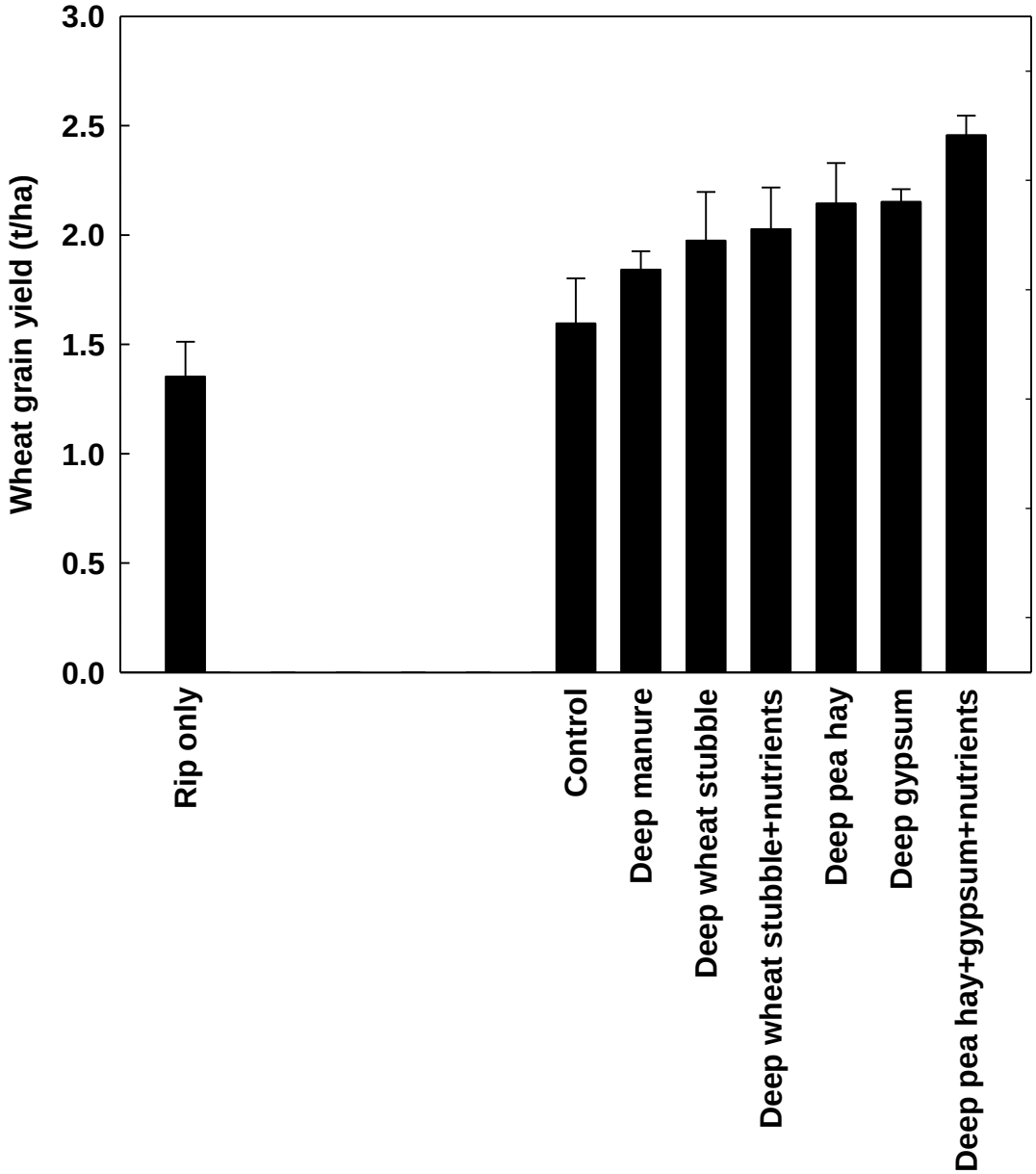
Treatments	Rates
Control	
Deep gypsum	5 t/ha
Deep liquid NPK	N&P to match DAP @ 80 kg/ha
Deep manure	8 t/ha
Deep pea straw	15 t/ha
Deep pea+ gyp+ NPK	15 t/ha, 5 t/ha, 80 kg/ha
Deep pea+ NPK	15 t/ha, 80 kg/ha
Deep wheat	15 t/ha
Deep wheat+NPK	15 t/ha, 80 kg/ha
Rip only	
Surface gypsum	5 t/ha
Surface manure	8 t/ha
Surface pea	15 t/ha


NEW HOLLAND
T8.350

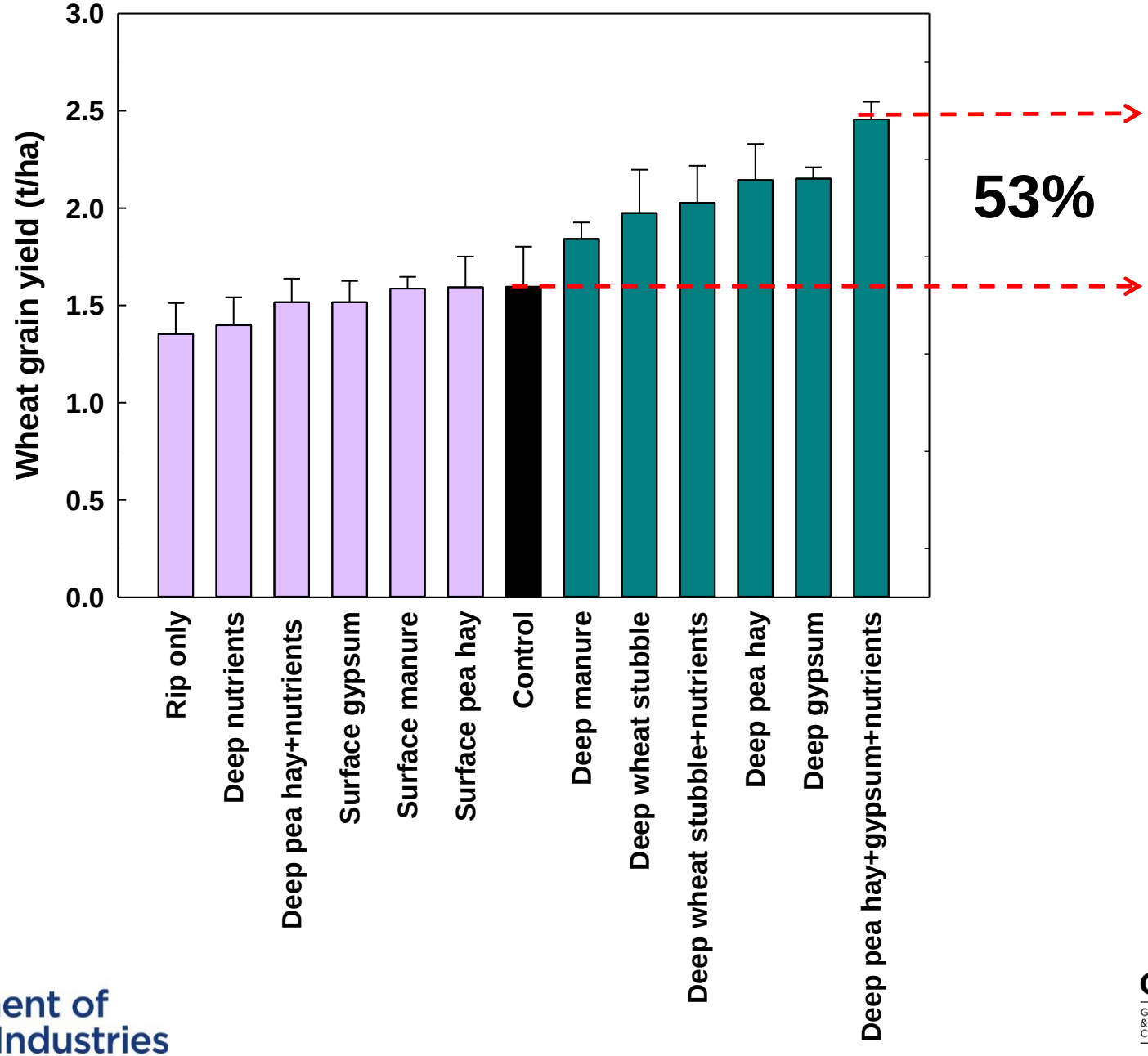
2017 trial

Amelioration of subsoil sodicity improves yield, 2018

Wheat, Lancer



Amelioration of subsoil sodicity improves yield, 2018



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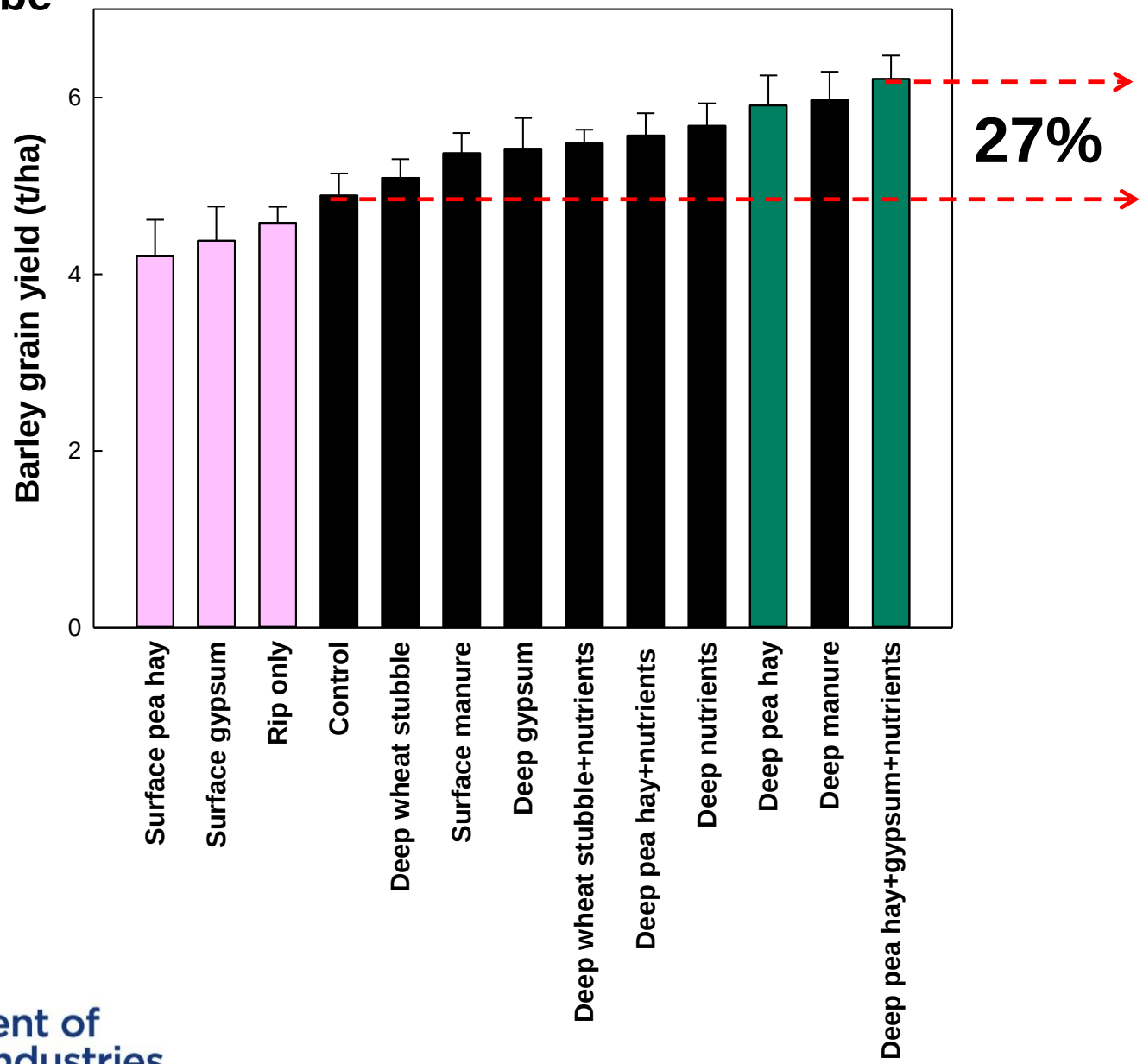
Amelioration of subsoil sodicity improves yield, 2017

Barley, LaTrobe



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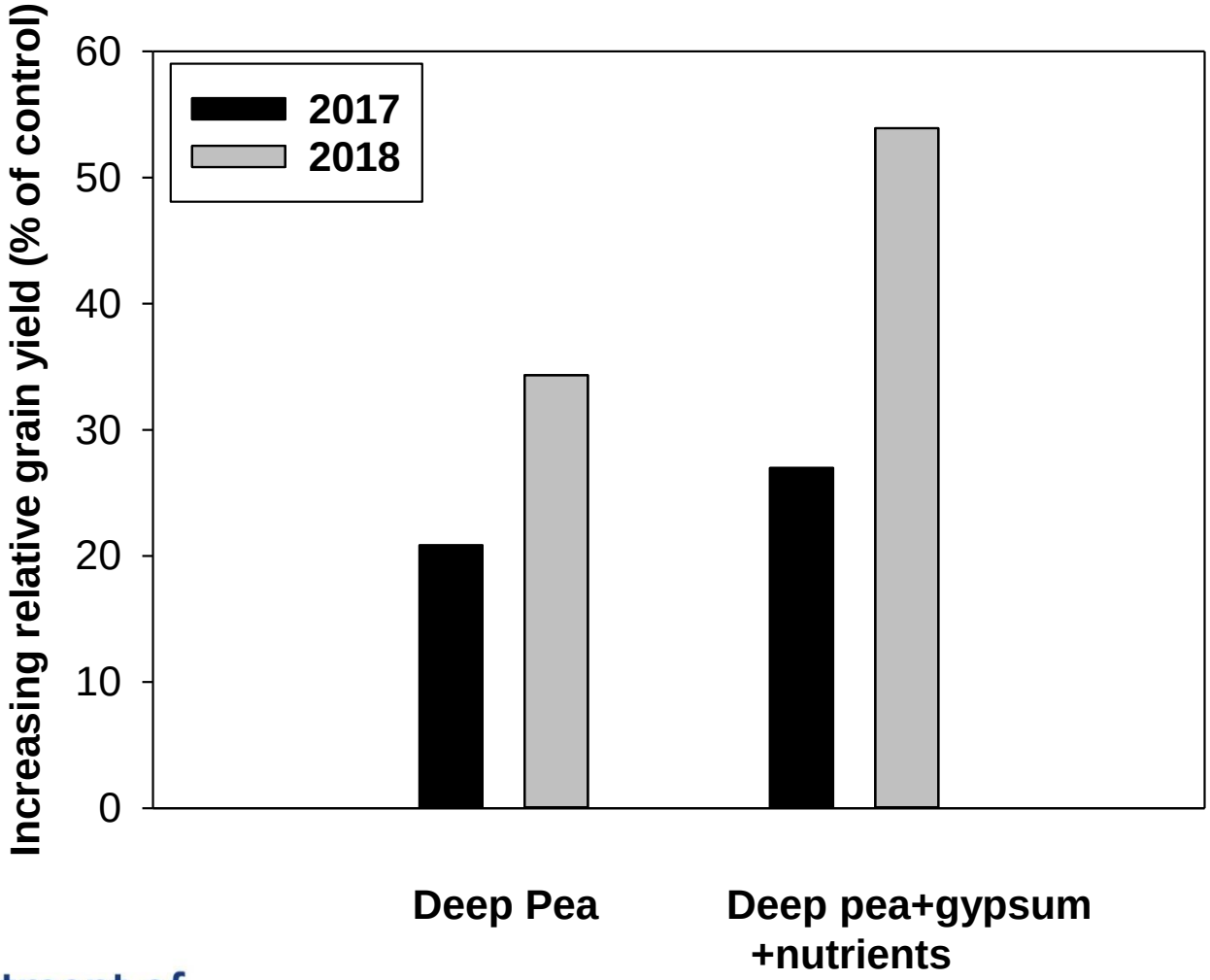
Top performing treatments so far



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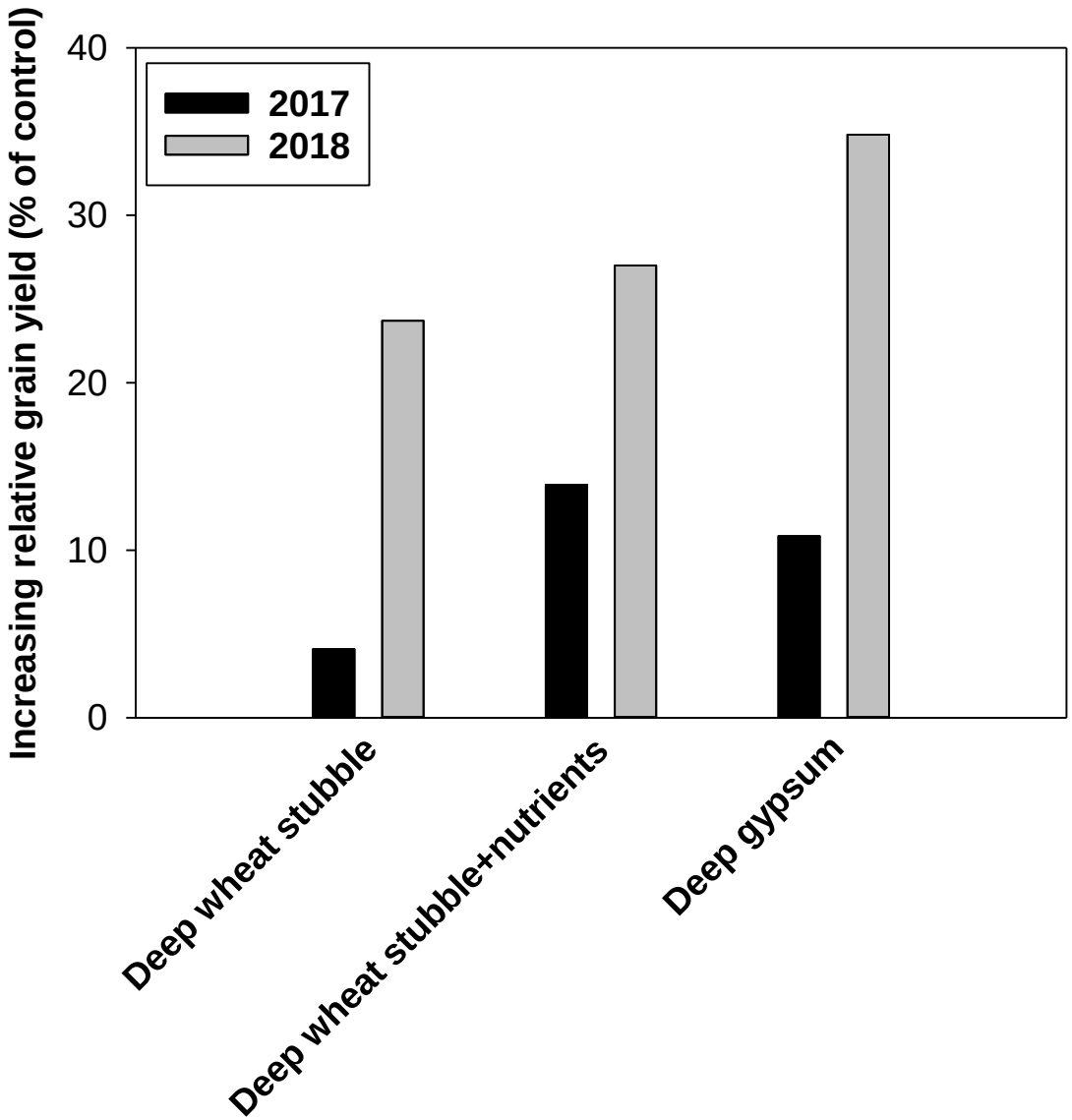
Interesting results…!



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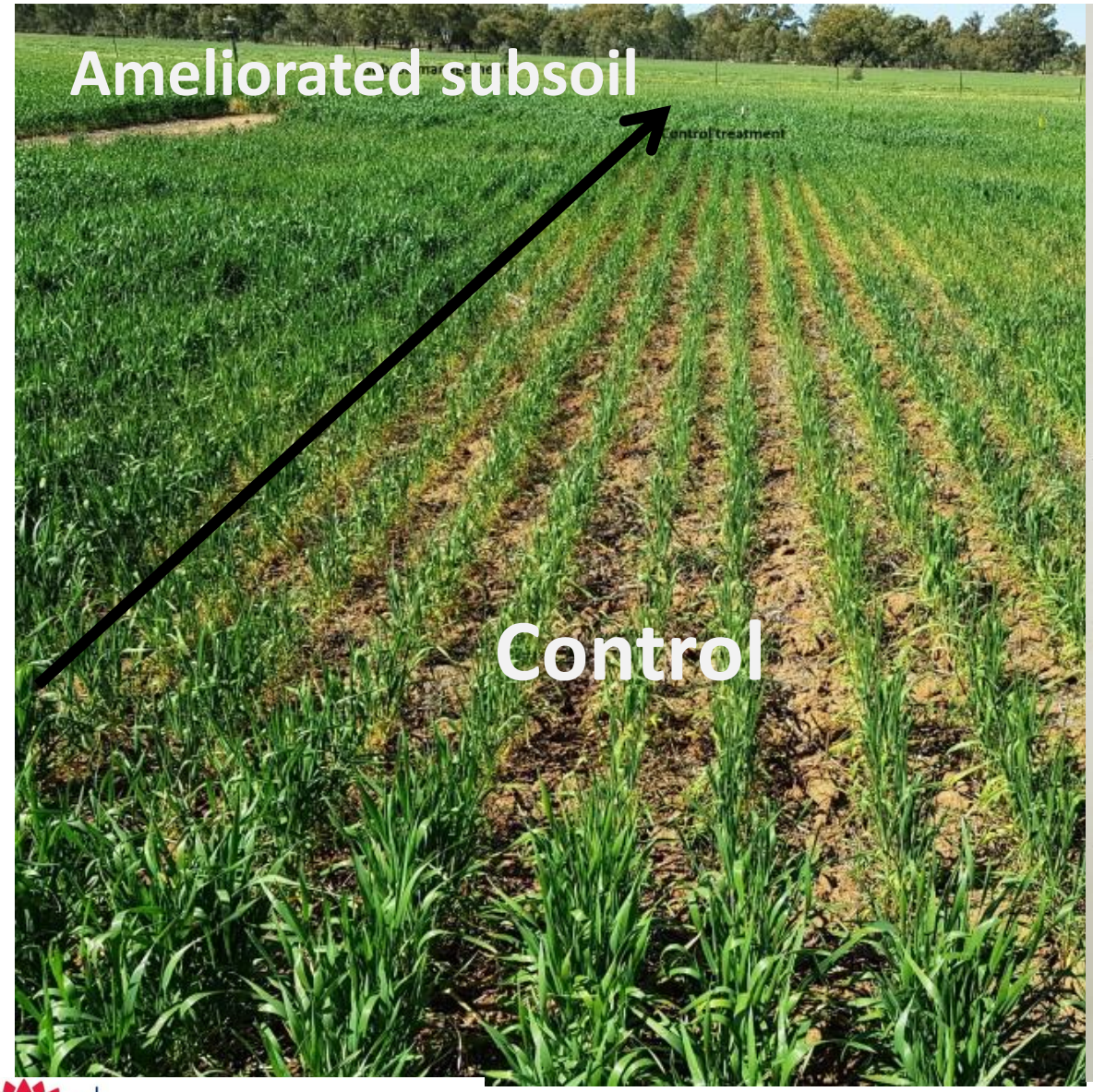
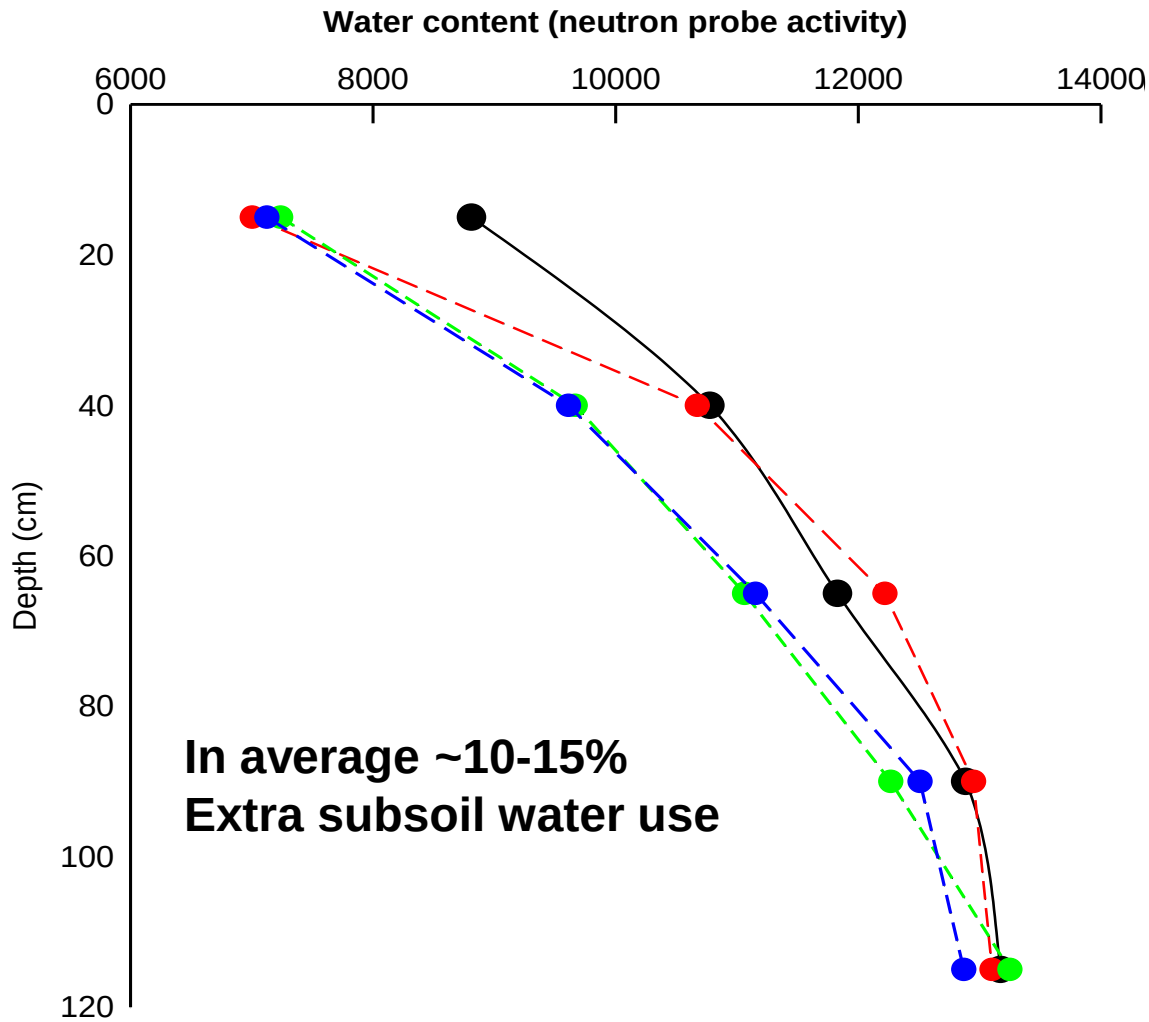
Crop responses to amelioration of subsoil constraints Sep 2018



Yield improvement is associated with increased subsoil water uptake



Control
Deep nutrient
Deep pea+gyp+nutrient
Deep pea hay

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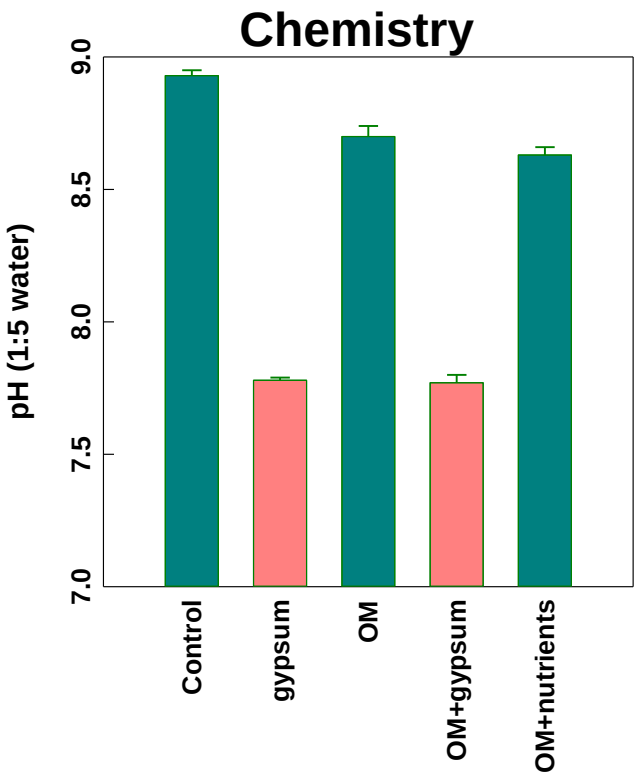
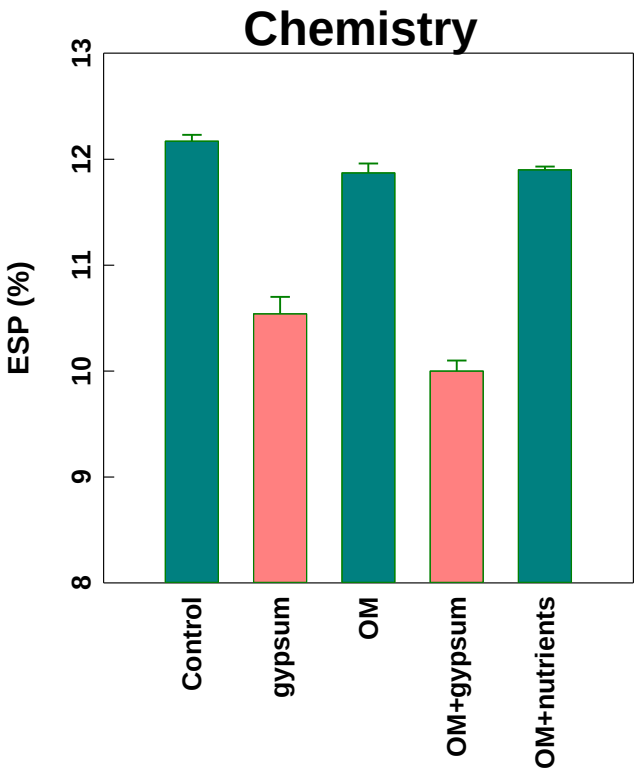
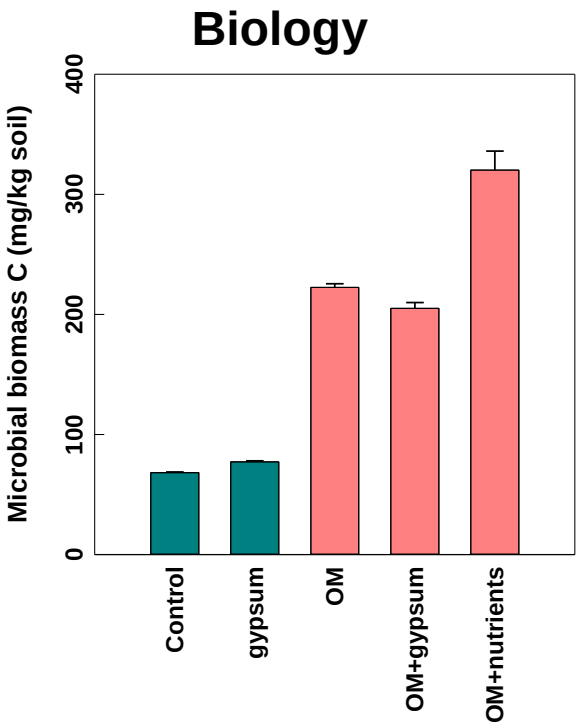
Yield improvement is associated with the changes in soil properties







Tavakkoli et al. Net dispersive charge, a new concept for dispersive soils. EJSS. 2016

Tavakkoli et al. The effect of cation–anion interactions on soil pH and solubility of organic carbon. EJSS. 2015

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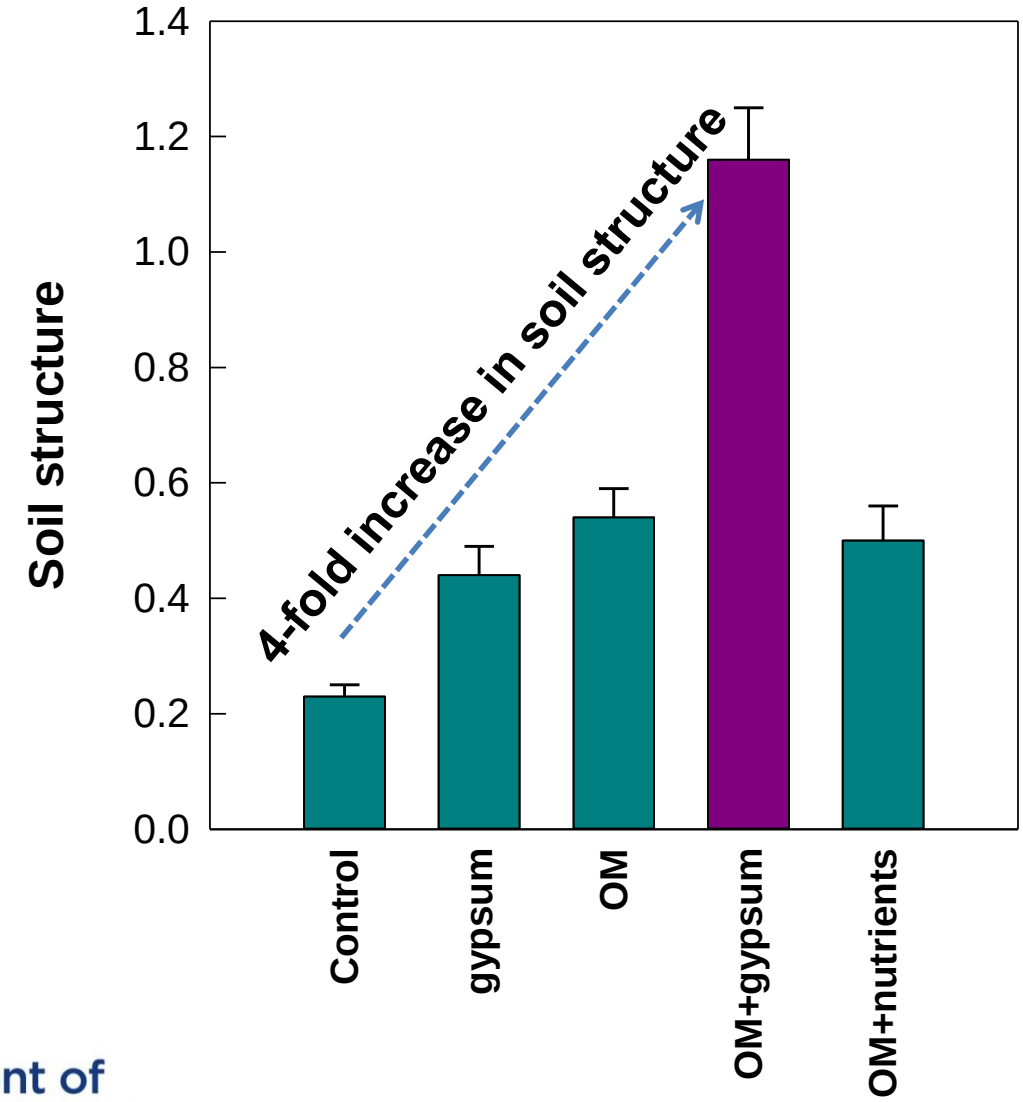

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25FEET
7.5m
1ft

Summary

Outcome:

- Deep placement of organic amendments and gypsum significantly increased yield

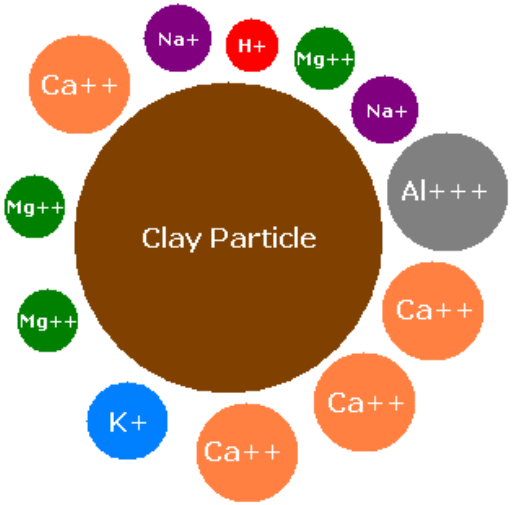
- **Mechanisms:**

i) reduction in net dispersive charge and pH
ii) enhanced microbial biomass C
iii) additive effect to give 4-fold enhanced aggregation
iv) at field level demonstration of increased PAW therefore addressing yield gap

Know your soil…
Saline, Sodic, Magnesic or All of the Above?

- Deep soil testing at meaningful intervals

Sampling for	Technique
pH (Water)	1:5 in water
Electrical conductivity	1:5 in water
Exchangeable cations (CEC)	
ESP	Calculated from CEC and exchangeable cations



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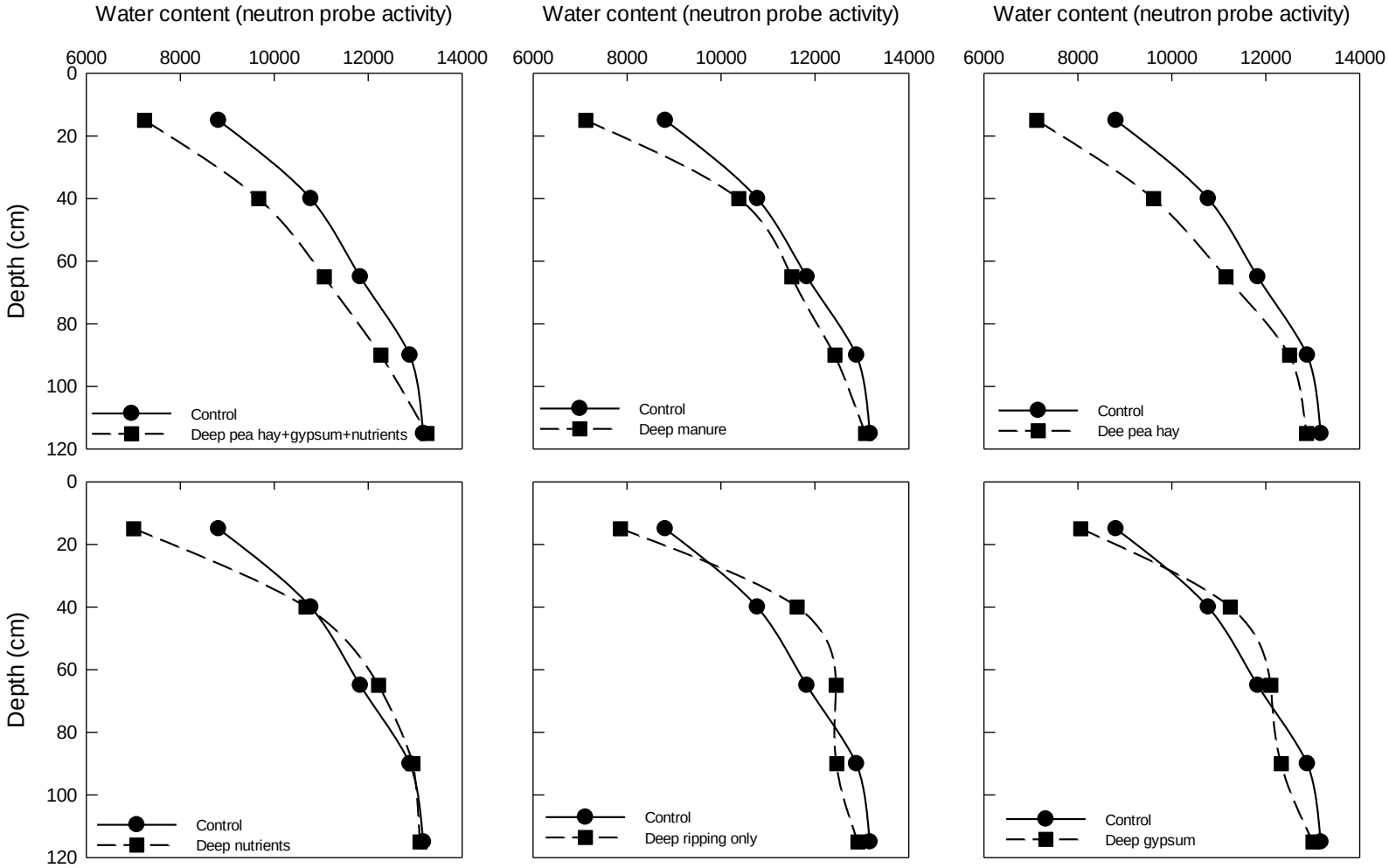
Soil development and organic matter chemistry

Direct evidence for microbial-derived soil organic matter formation and its ecophysiological controls

Kallenbach et al. Nature Communications (2016)

Yield improvement is associated with increased subsoil water uptake



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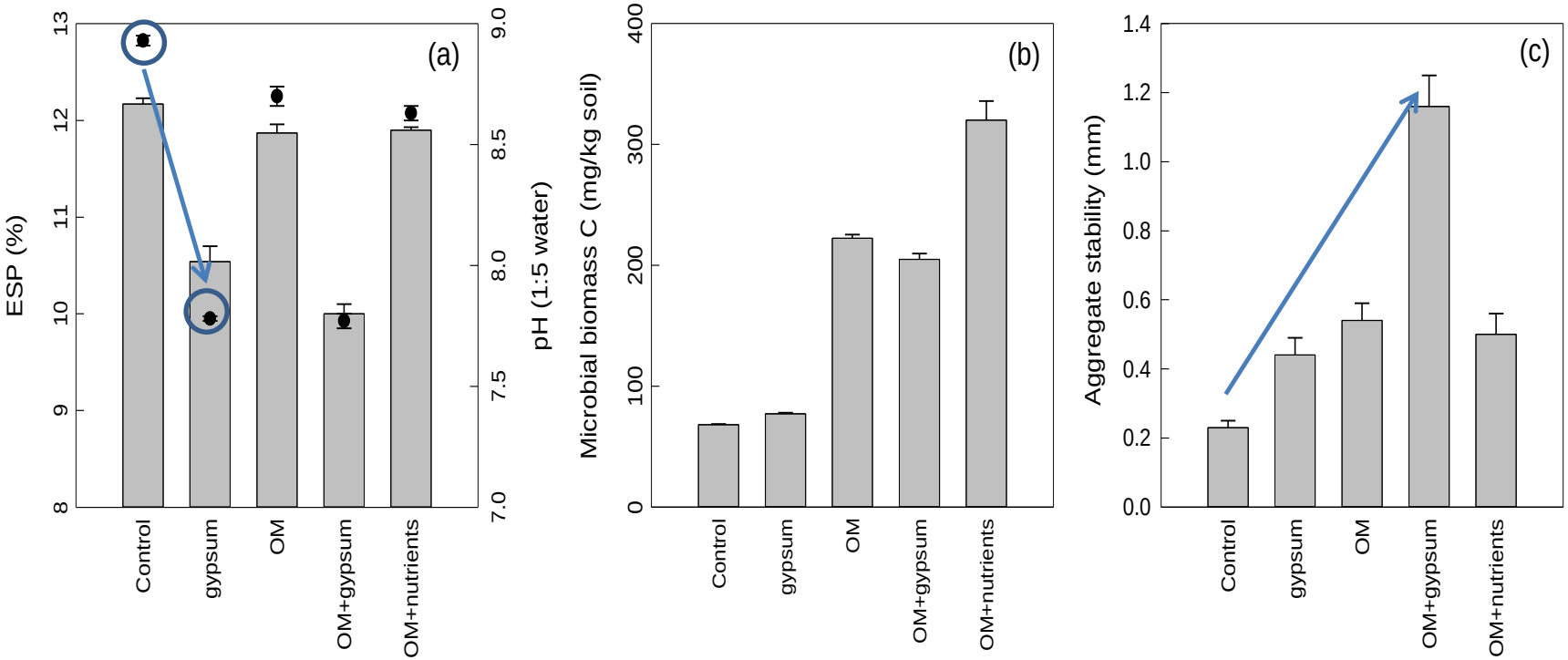

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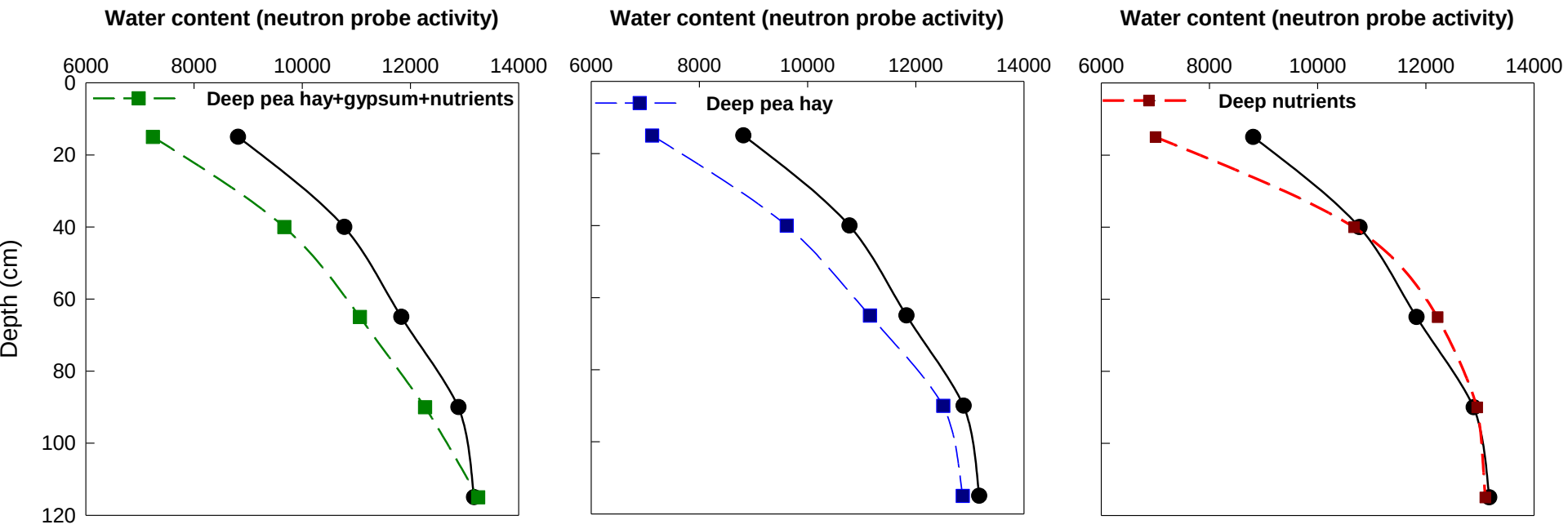

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