Improving canola productivity by ameliorating sodic dispersive subsoils under dryland conditions in southern NSW

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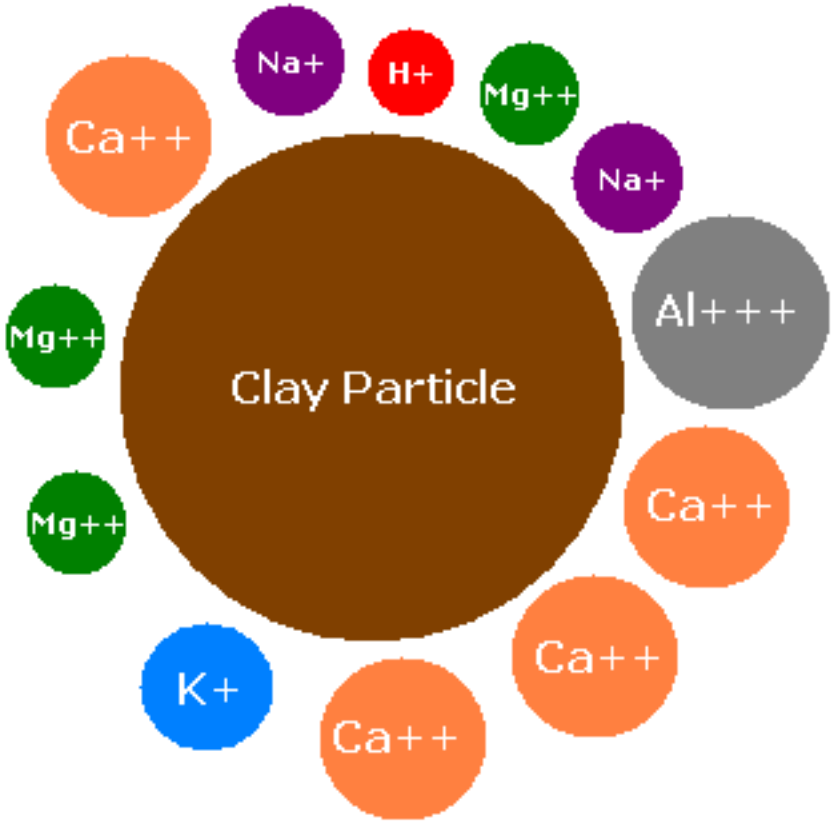
Sodic dispersive soil



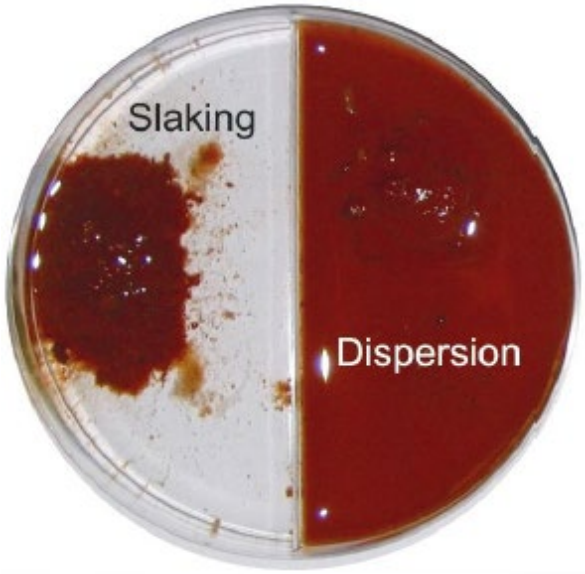
$$ESP = \text{Exchangeable } \{(Na)/(Ca + Mg + K + Na)\} \times 100$$

ESP value for defining sodic soil

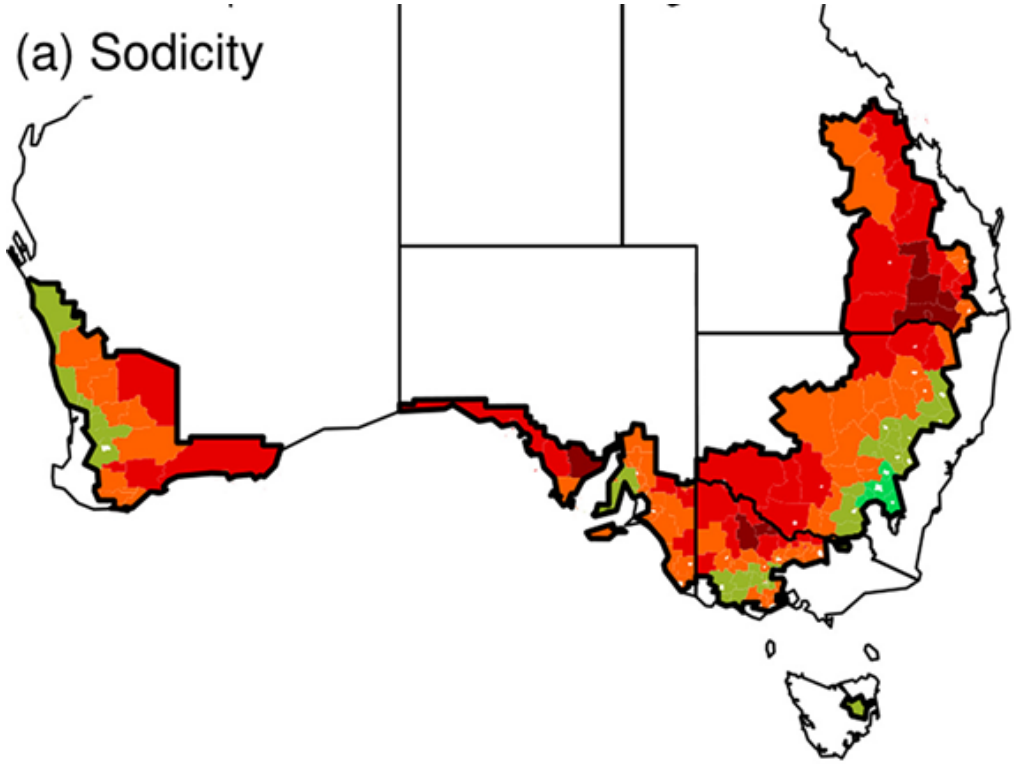
>15 (Worldwide)

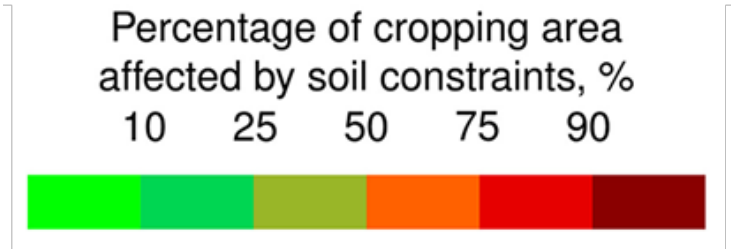
>6 (Australia)

very low contents of soluble minerals (esp. Ca)

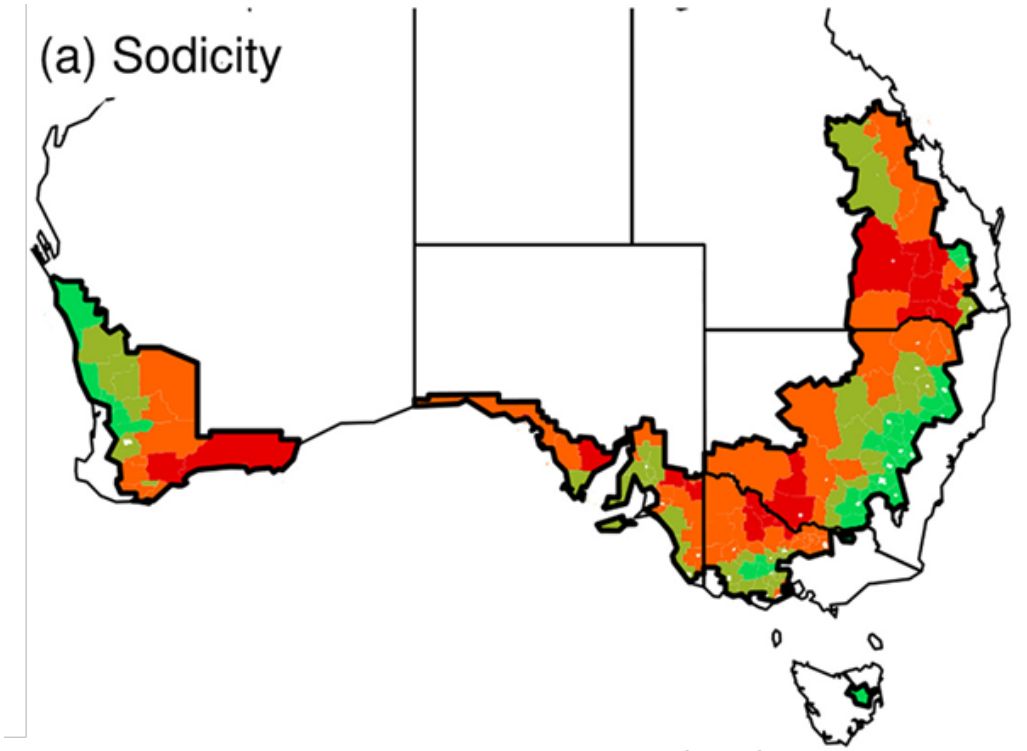


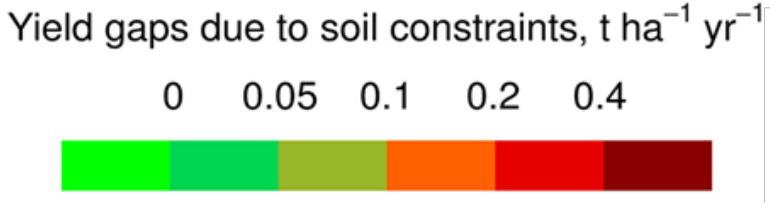
Yield gap due to sodic dispersive soil





$A 1.3 billion per annum



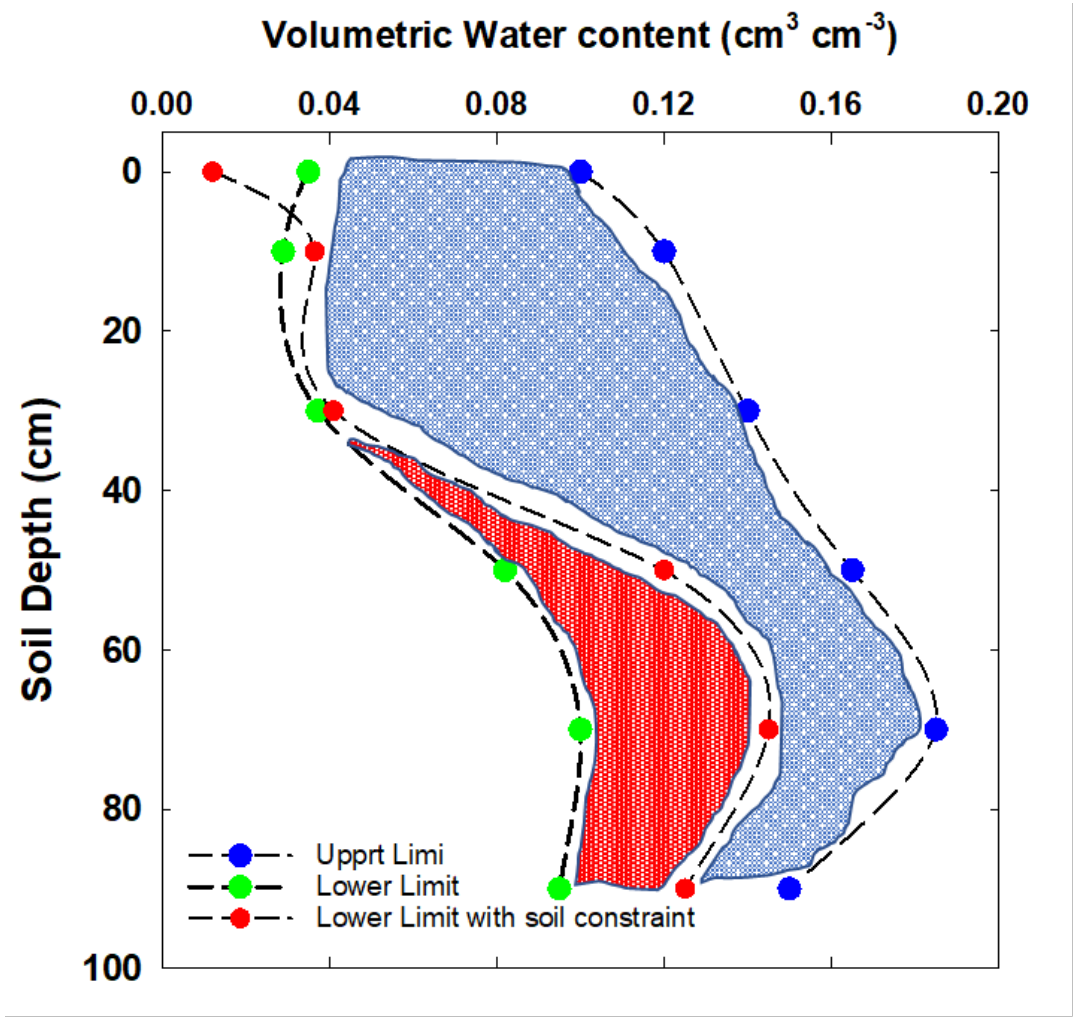


Orton et al. 2018, Land Degradation & Development: 29, 3866-3875

Poor water use efficiency

Poor soil structure
Low infiltration rate
Transient waterlogging

Poor soil profile recharge



Poor accessibility of subsoil water

Transformation of subsoil structure

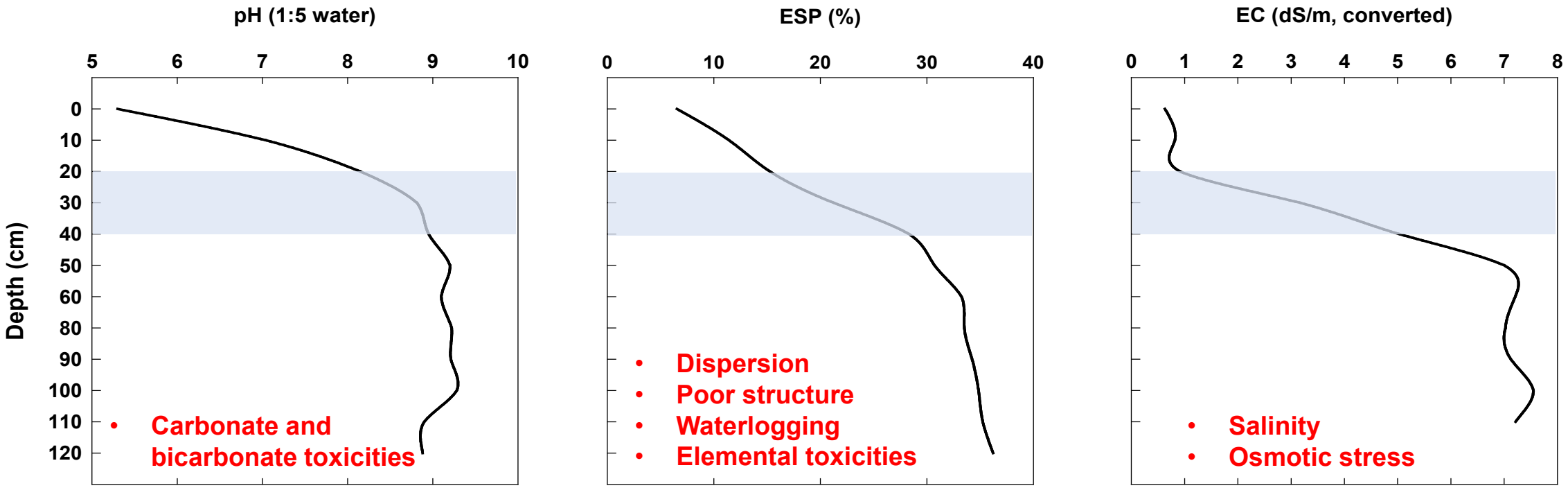
Potential to increase grain yields by up to 70%

Control 30-40 cm

Subsoil manure 30-40 cm

Sale et al. 2021, Advances in Agronomy:165, 249-300

Site characteristics: Rand Southern NSW



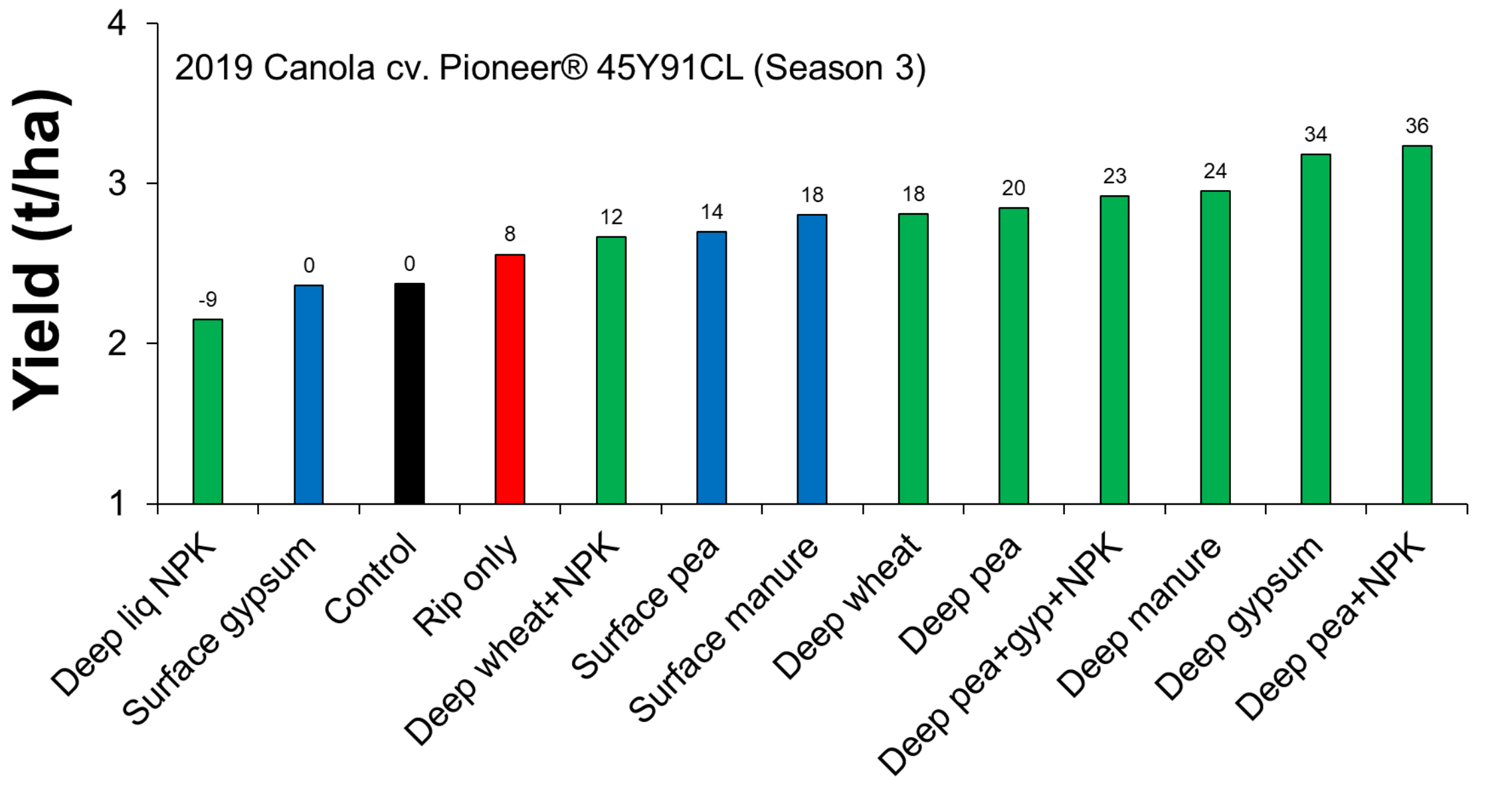
Amendments application in 2017

Amendments	Rates
Control	
Deep gypsum	5 t/ha
Deep liquid NPK	N to match chicken manure
Deep manure	8 t/ha
Deep pea	15 t/ha
Deep pea+gyp+NPK	15 t/ha, 5 t/ha, N to match chicken manure
Deep pea+NPK	15 t/ha, N to match chicken manure
Deep wheat	15 t/ha
Deep wheat+NPK	15 t/ha, N to match chicken manure
Rip only	
Surface gypsum	5 t/ha
Surface manure	8 t/ha
Surface pea	15 t/ha

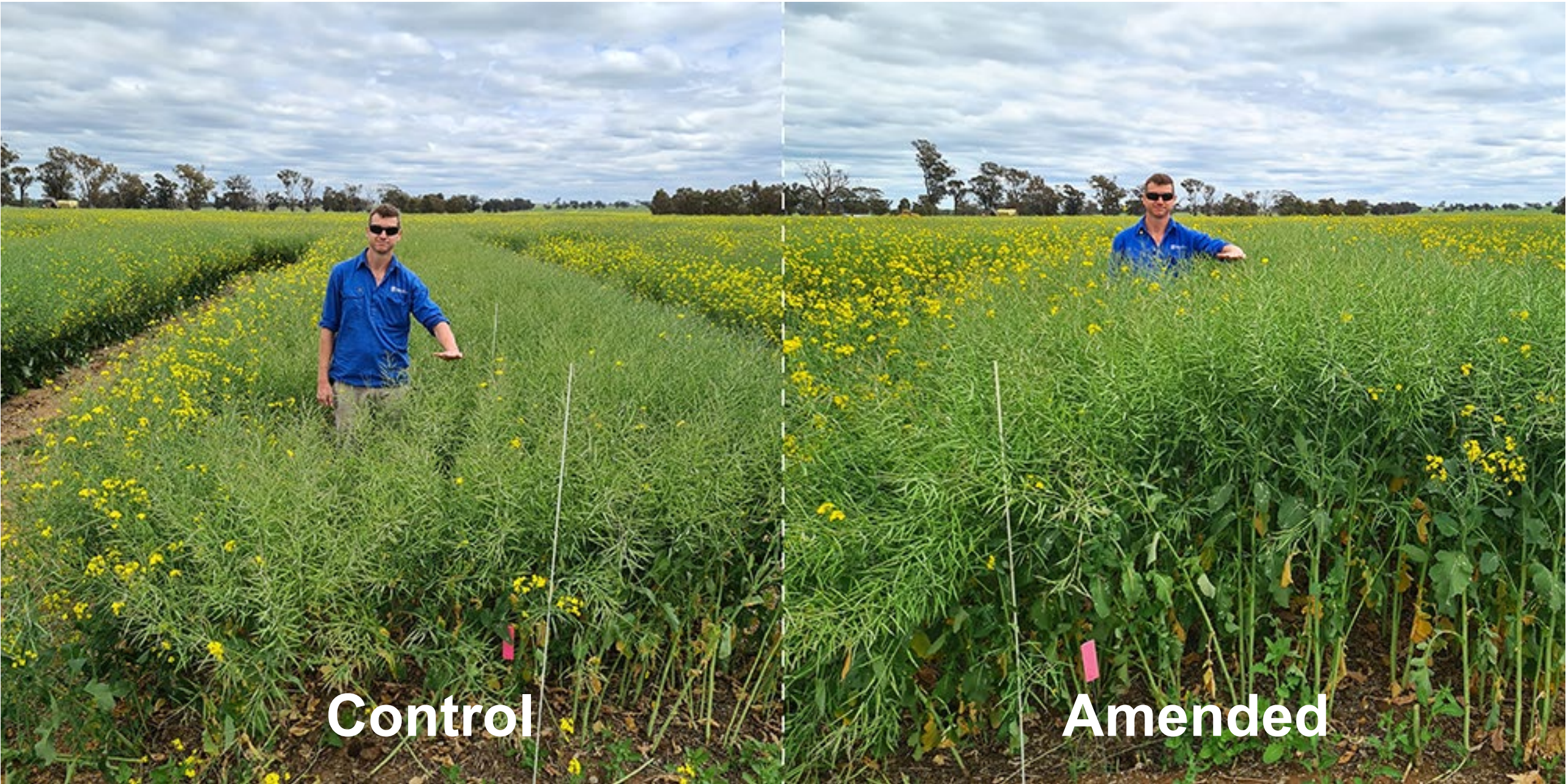
Deep/subsoil amendment bands

- At 20 ~ 40 cm depth
- 50 cm spacing

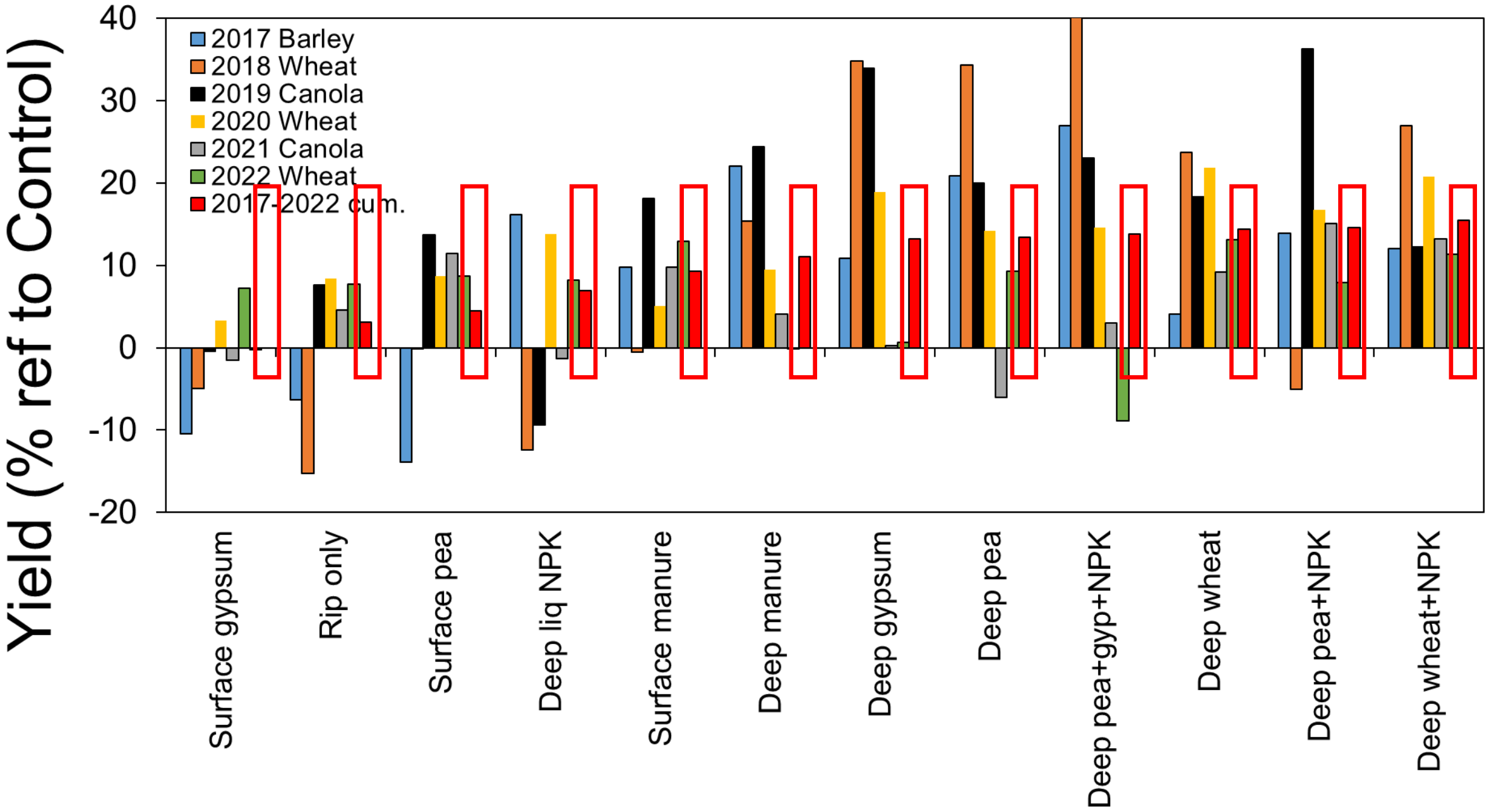
Yield gain following subsoil amelioration



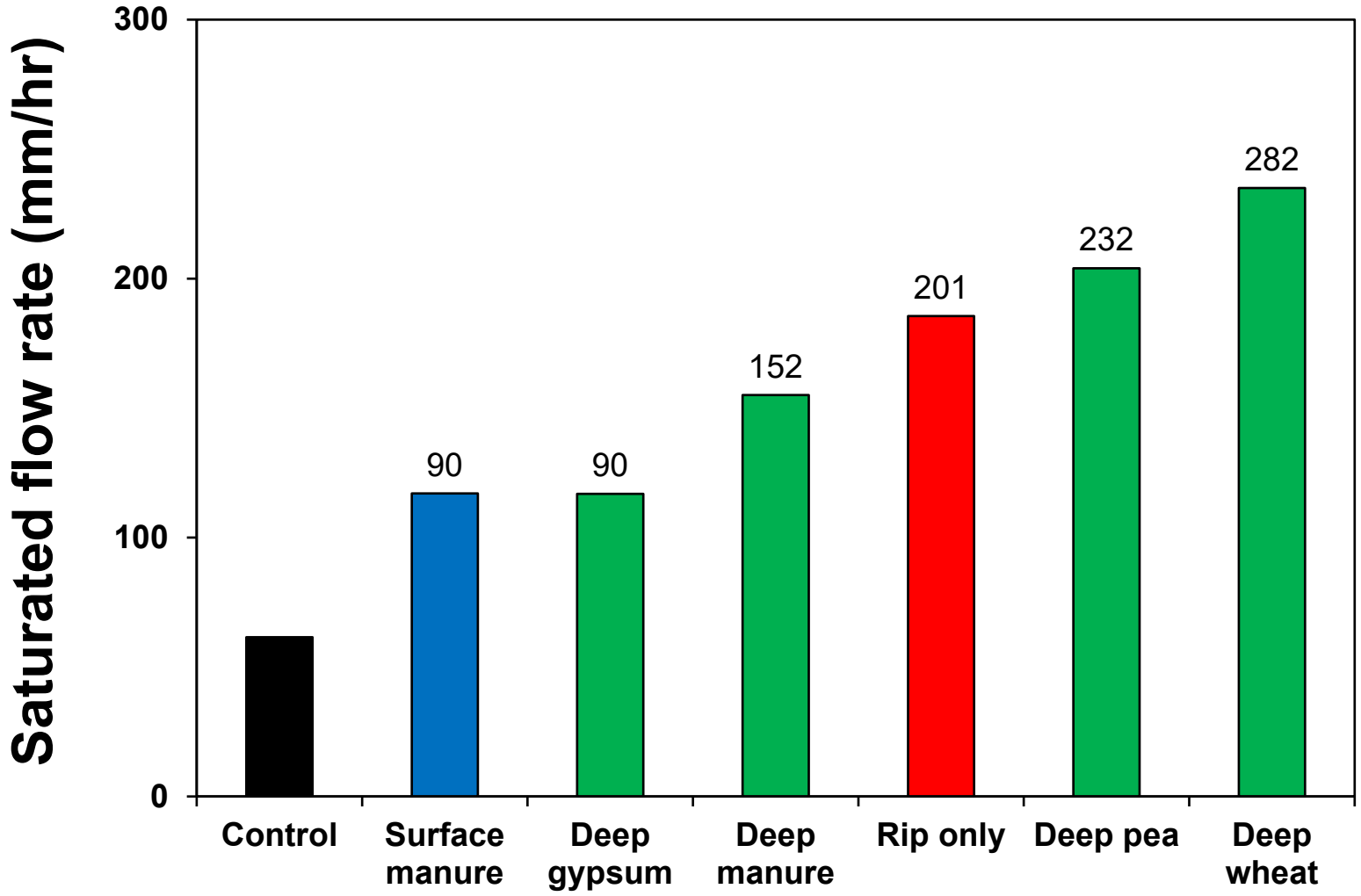
Yield gain following subsoil amelioration



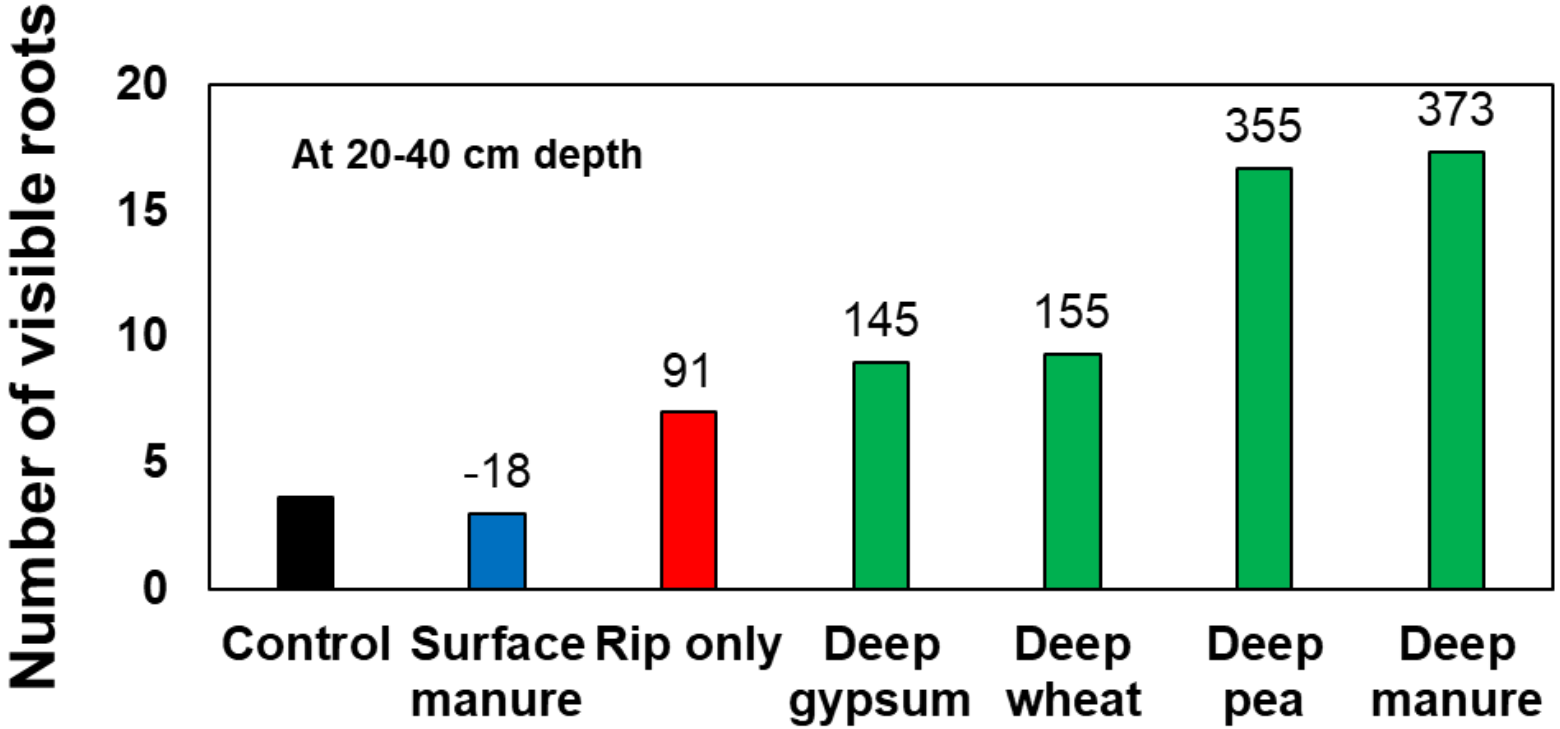
Residual effect of subsoil amelioration



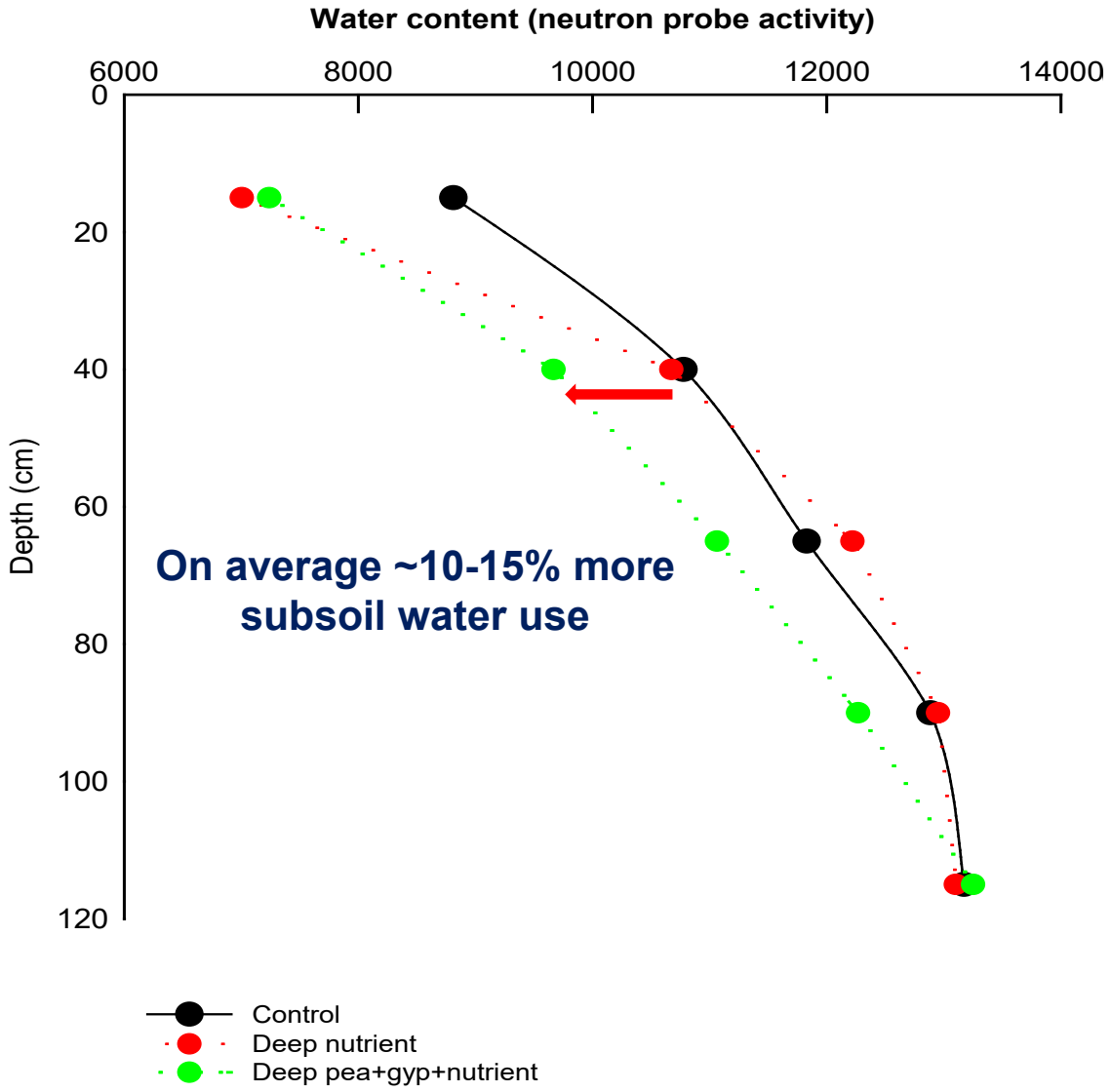
Amelioration improves the infiltration rate



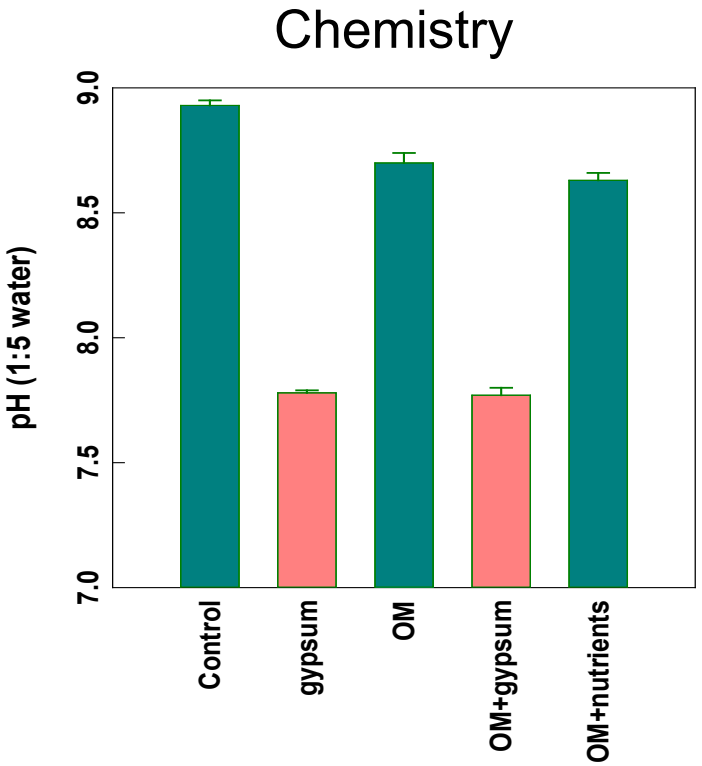
Deep banding of OM improves root growth

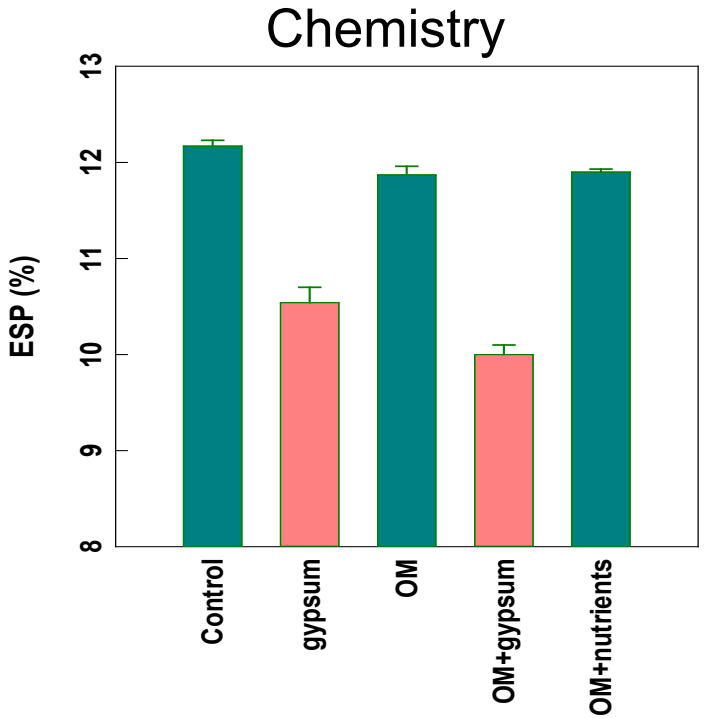


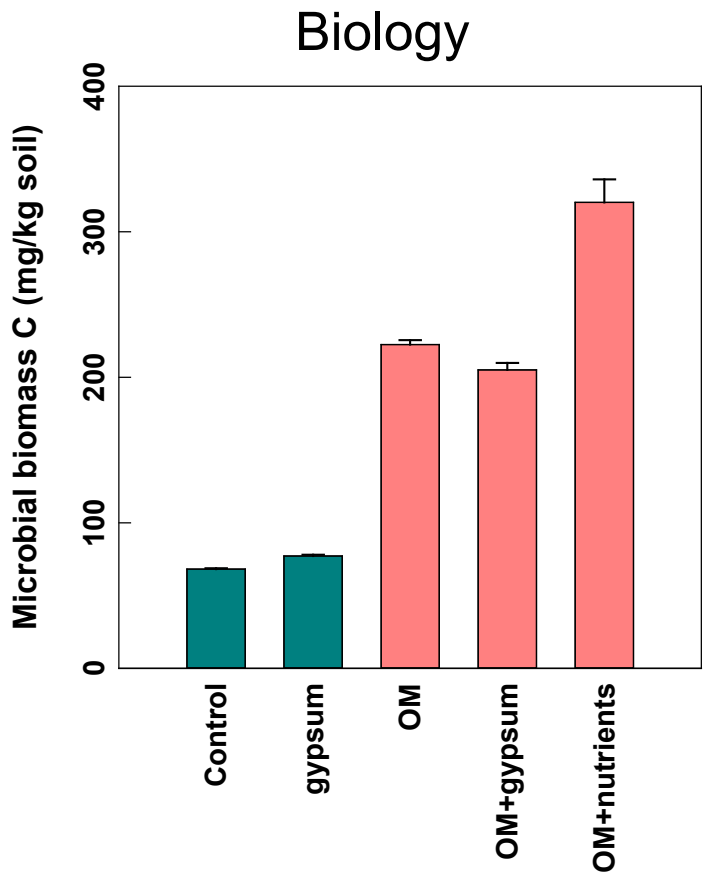
Yield improvement is associated with crop water use



Yield improvement is associated with changes in soil properties

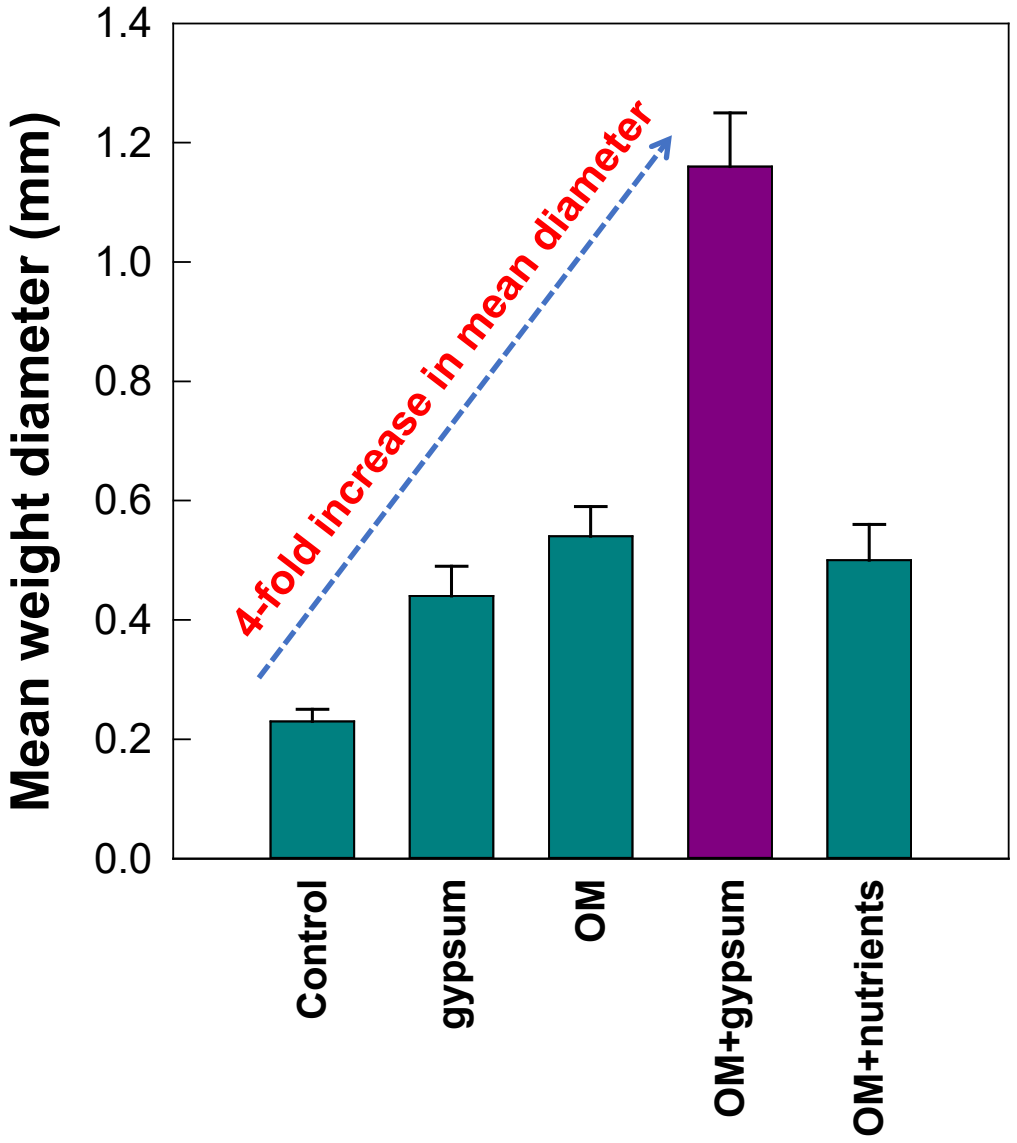






Uddin et al. 2022, Plant and Soil: 480, 227-244
Fang et al. 2020, Soil Biology and Biochemistry: 145, 107800

Yield improvement is associated with better soil structure



SUMMARY

Outcome

Deep banding of organic amendments and gypsum significantly

- Increased the grain yield (up to ~54%)
- Demonstrated a residual yield benefit of 16% (averaged across six seasons)

Mechanisms

Amendments with different modes of action are the key to tackle multiple soil constraints

- Reduction in pH and ESP of sodic dispersive subsoil
- Enhanced microbial activities and soil aggregation
- Increased infiltration rate
- Better root proliferation
- Improved crop water use

ACKNOWLEDGEMENTS

NSW DPI team

Soils South

Southern Cropping Systems

Ehsan Tavakkoli

DAV00149

"Understanding the amelioration processes of the subsoil application of amendments in the Southern Region"

Thank you all