SOIL AMELIORATION: WHERE WILL IT PAY DIVIDENDS

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

Australian Government

National Landcare Programme

Roger Armstrong, Nigel Wilhelm, Ehsan Tavakkoli, Geoff Dean, Bianca Das, Brian Hughes, Jin Jian, Daniel Hendrie, Katherine Dunsford, Garry O'Leary, Craig Beverly, Adam Buzza, Max Madovan

DAV00149, DJP2209-002RTX & NLP4-GKXBV5N/DJP2204-011SAX

Application of nutrient enriched organic matter

What is soil amelioration?

- Can be with or without an amendment e.g. deep ripping
- Application of an ‘amendment’ designed to overcome soil ‘constraints’ to enable crops to achieve their full yield potential
- Not a ‘new’ management strategy
- Amendments can be both ‘organic’ e.g. animal and plant, or ‘inorganic’ e.g. lime, gypsum or nutrients
- Can be applied to topsoil, subsoil or both
- Often applied at high rates (especially organic matter)

WHAT IS LIMITING ADOPTION OF SUBSOIL AMELIORATION

- high upfront costs of implementation ($/ha)
- ready access to (relatively) cheap ameliorants & suitable machinery

Need reliable predictions of where soil amelioration will and, just as importantly, will not improve yields

Soil amelioration can potentially improve yields & profit

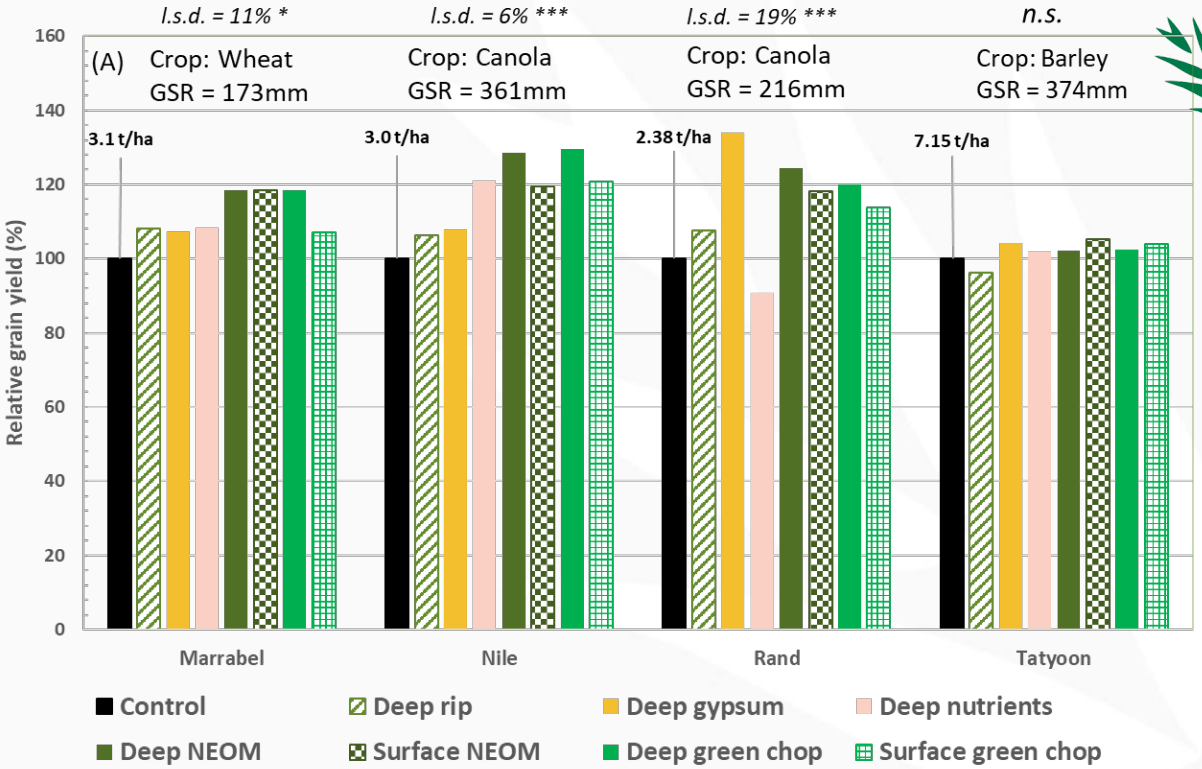
but

not suitable for all soil types and environments

- Do you have a ‘problem’?
- Soil water availability (topsoil and subsoil) is central to impact of soil amelioration
- What are the soil constraints (and where do they occur – 3D)?
- Benefit of variable rate approach

Control

Deep NEOM

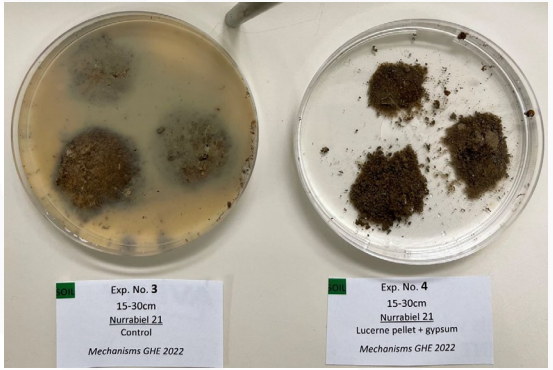


Relative grain yield response (%) of crops (control = 100%) to different soil amelioration strategies with amendments applied either to the soil surface or subsoil (deep) at four sites in the HRZ (2019).

GSR = growing season rainfall (mm). 'NEOM' = animal manure pellets; 'green chop' = lucerne or field pea hay pellets.

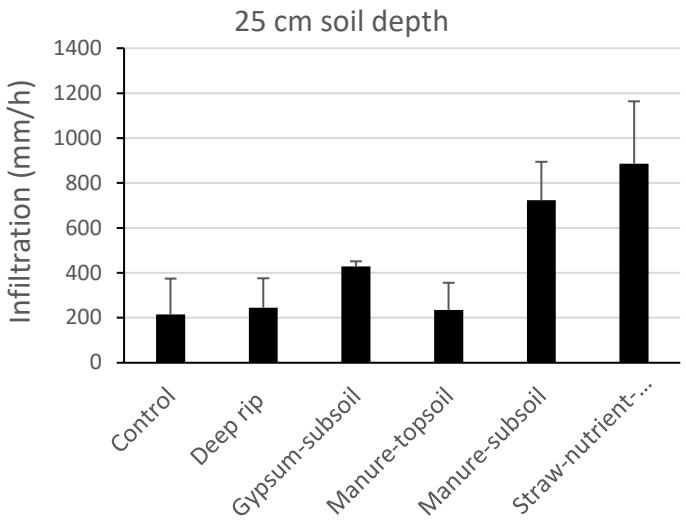
WHAT CAUSES THE YIELD RESPONSES?

- Improved root growth in the amelioration zone
- Improved soil structure
- Increased 'bucket size'
- Improved nutrition – N, **P**, S, K
- Water-logging increases likelihood of response
- Decrease in soil resistance (Unkovich et al, 2023)



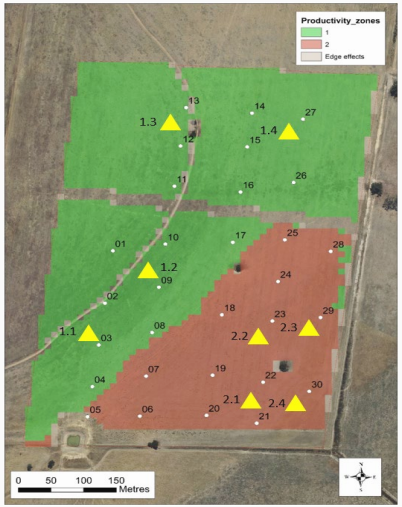
Largest effect of amelioration on root growth occurs in the amelioration zone

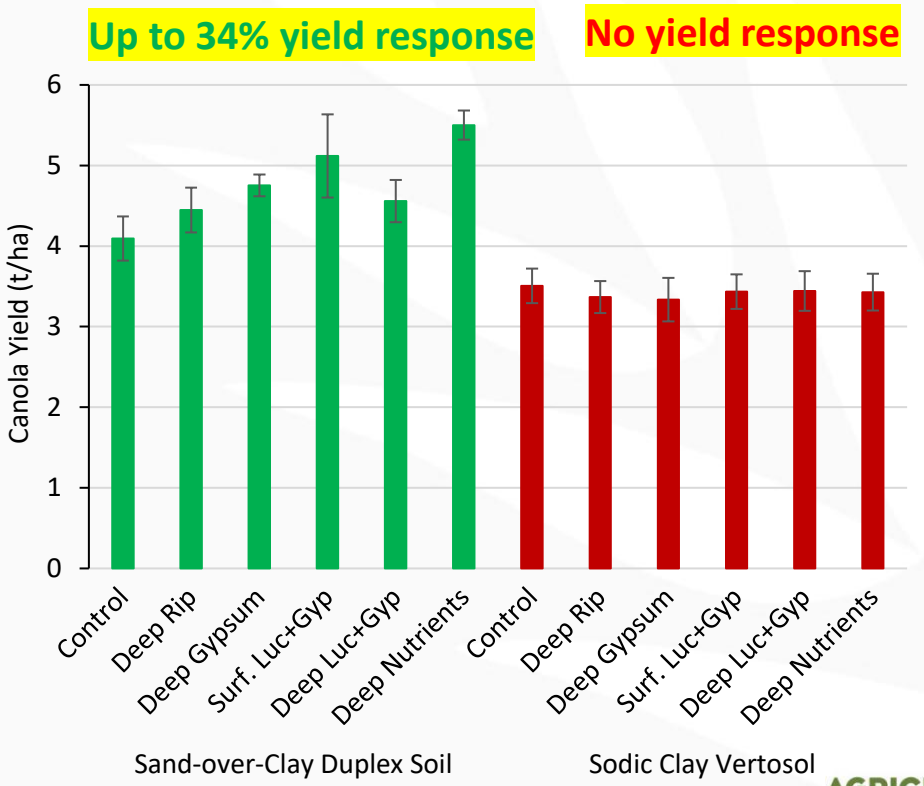
Increasing the size of the bucket



APPLICATION OF TARGETED SOIL AMELIORATION AT NURRABIEL (DUPLEX vs SODIC CLAY): CANOLA YIELD IN 2021 (GROSS MARGIN FOR CONTROL WAS $1835/HA)

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION



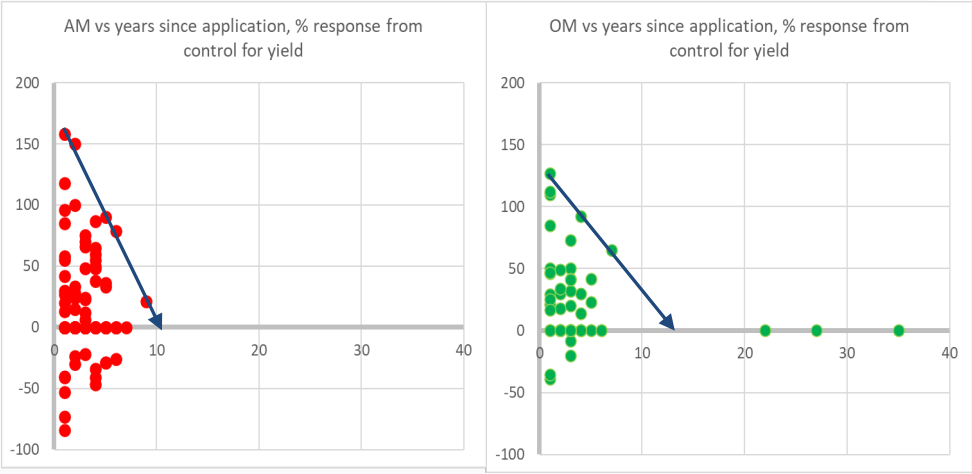


Source: Hendrie et al (2023)

AGRICULTURE VICTORIA

MONITORING OF EXISTING TRIALS

1. Plant (OM) and animal manure (AM) increased yields by **average** of 12%
2. Potential residual value declines slowly (up to 10 years)
3. Largest gains on Chromosols & Sodosols: little benefit on Vertosols (OM) & Calcarosols (AM)

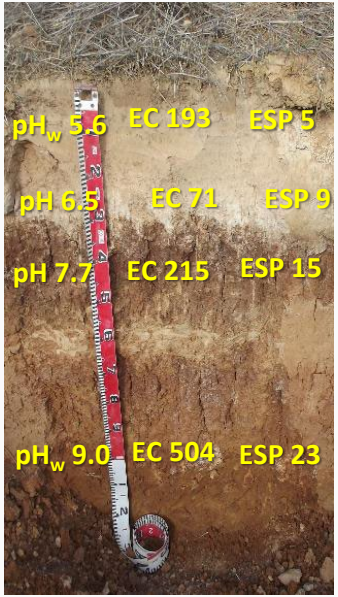


DEPTH WHERE CONSTRAINTS OCCUR WITHIN THE PROFILE IS CRITICAL TO SUCCESS OF SOIL AMELIORATION!

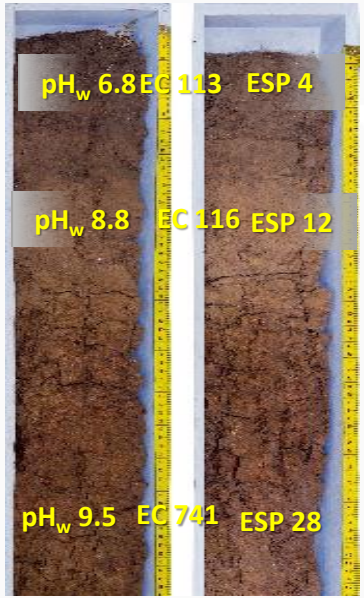
Location of constraints in the soil profile and depth of amelioration

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

Marrabel (Sodosol)



Rand (Sodosol)

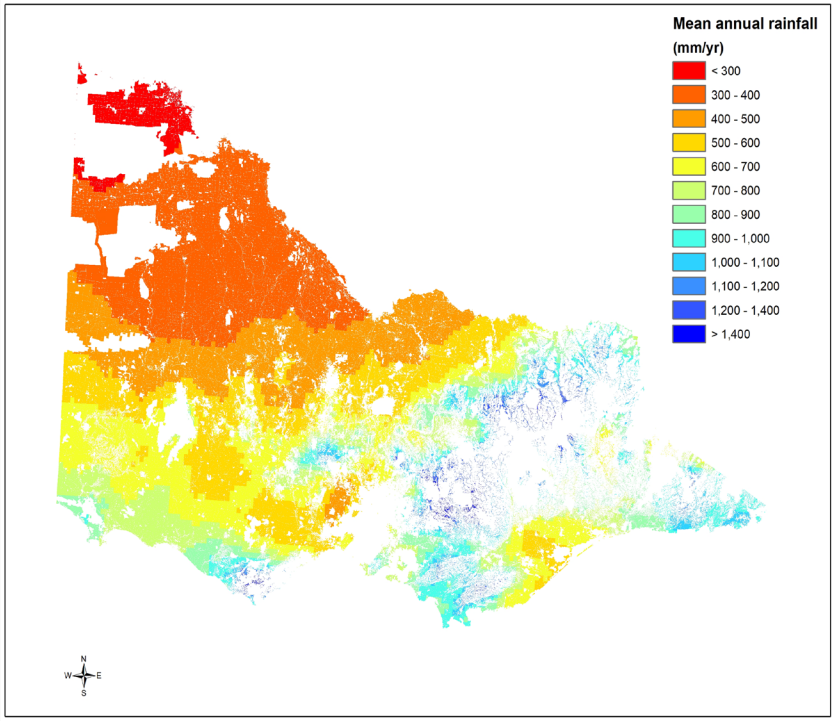


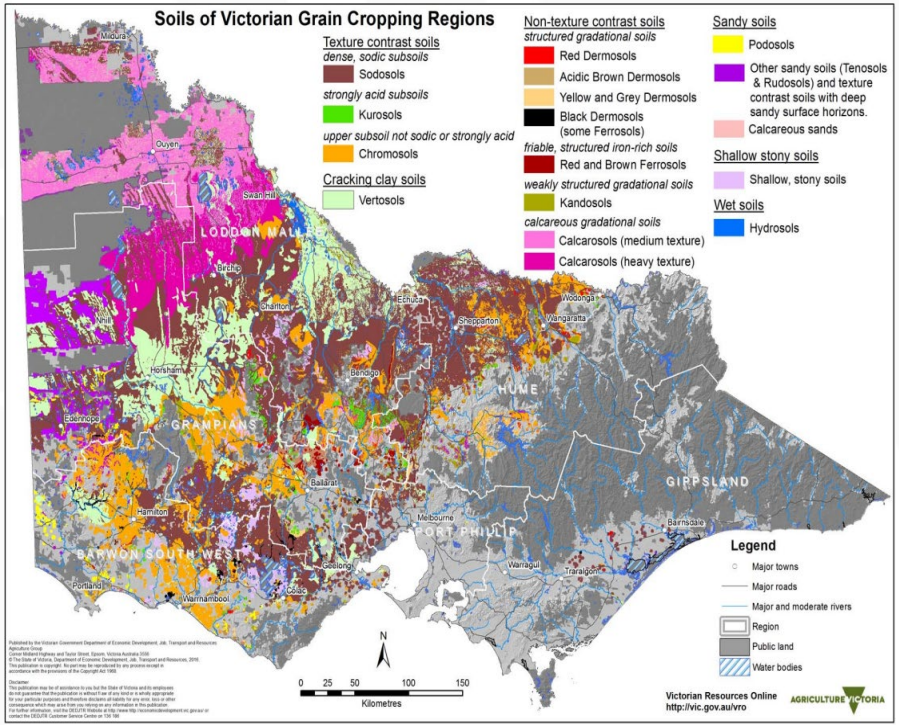
Nile (Chromosol)

Tatyoon (sodosol)

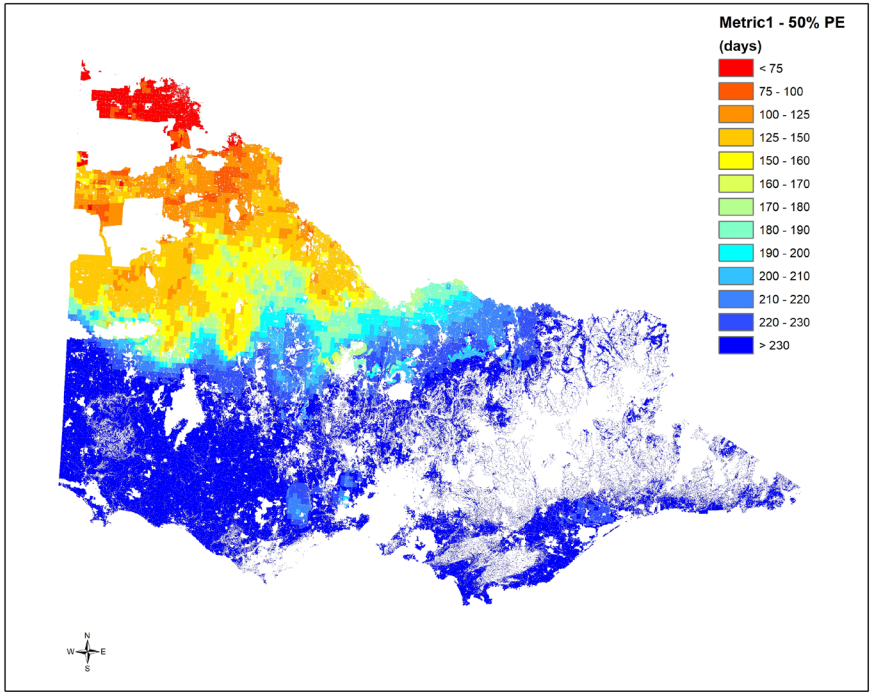
Max. depth of amelioration

Where does the combination of rainfall and soil texture suggest that soil amelioration will potentially be worth trying?

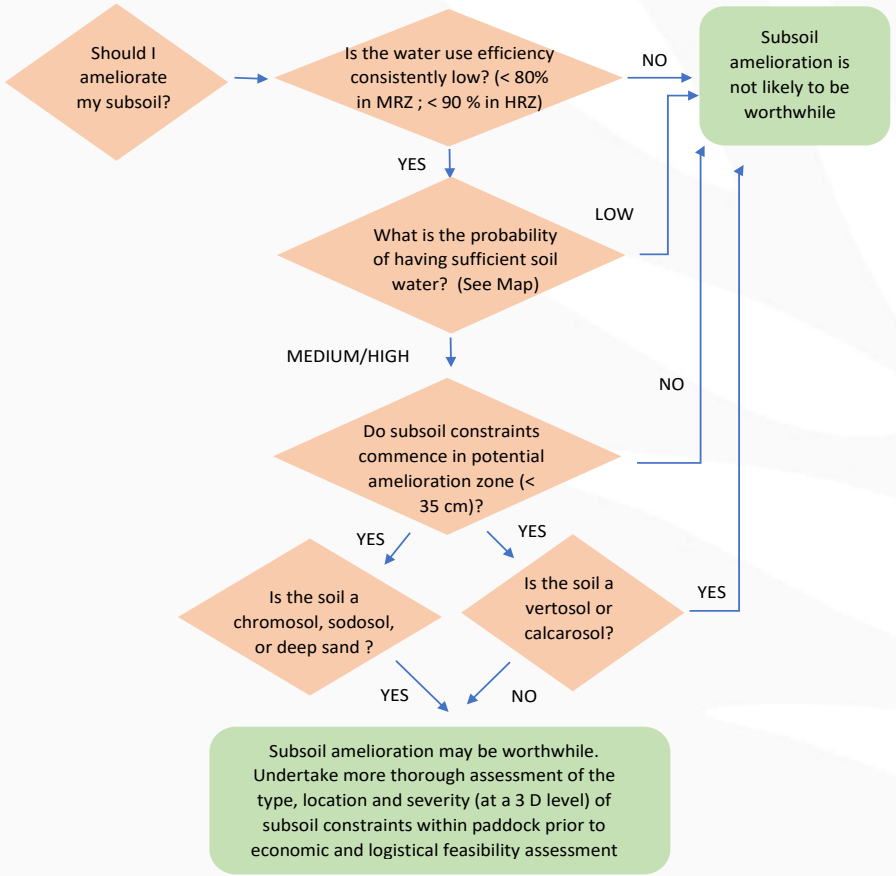




Probability of number of days exceeding critical soil water threshold (0.3 of available range) in the 20-40 cm layer



A (draft) decision support framework for assessing whether to ameliorate subsoils for medium and high rainfall zones of south-eastern Australia



SUMMARY

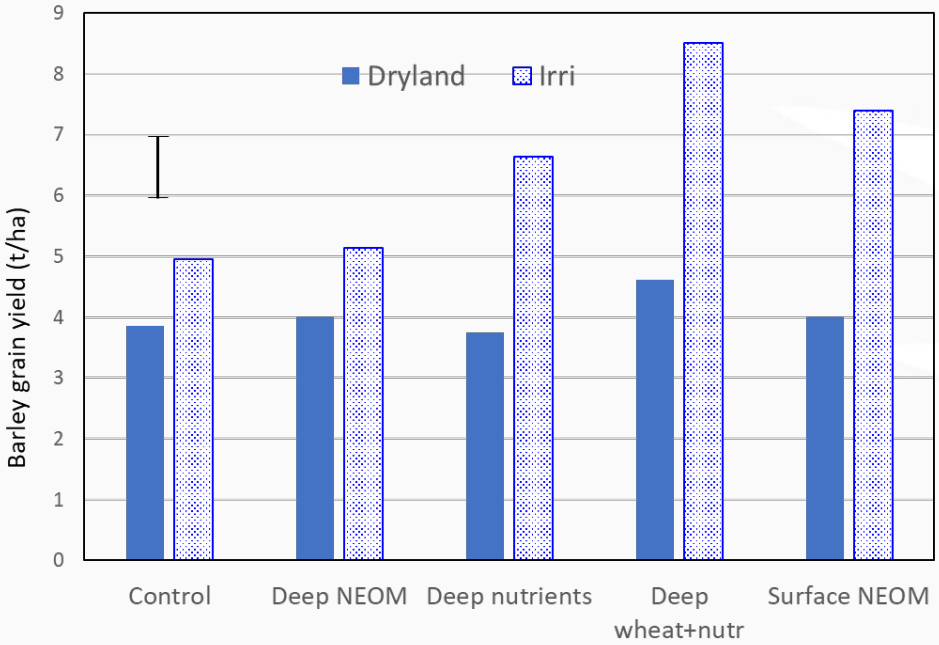
- **Soil amelioration can improve yields and profitability but effectiveness varies with soil conditions and environment.**
- Decision support tool - Do you have a ‘problem’?
  - Soil water availability
  - What are your soil constraints and where do they occur?
- Variable rate approach
- Availability of commercial scale machinery and suitable ameliorants




We wish to acknowledge the many grower co-operators who generously hosted field trials but also other projects where we have sourced data. We are also very grateful to the numerous technical staff who established and maintained these trials and participated in the data collection that underpins the analysis used in this presentation.

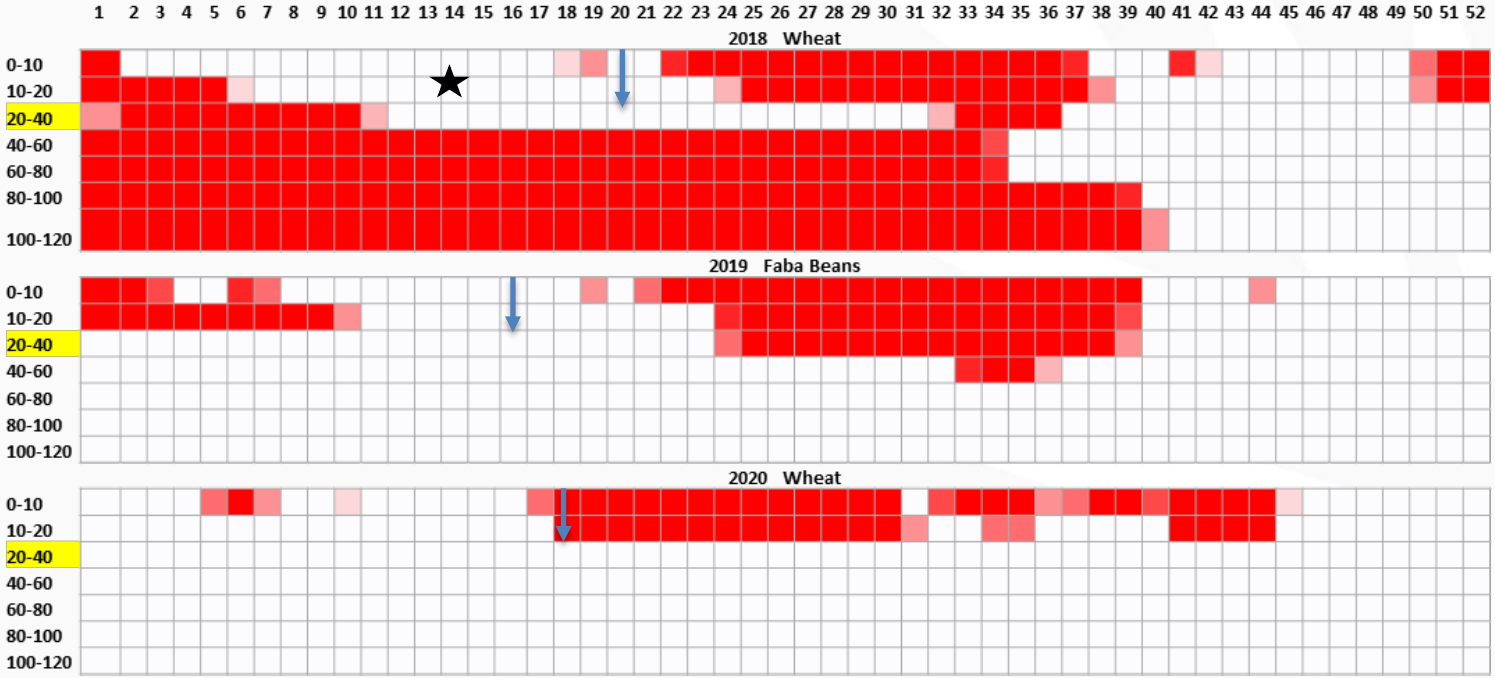
Work presented was funded through the projects DAV00149, DJP2209-002RTX & NLP4-GKXBV5N/DJP2204-011SAX

EFFECT OF PRE-SOWING IRRIGATION ON BARLEY (PBC, 2020)



Max. depth of amelioration

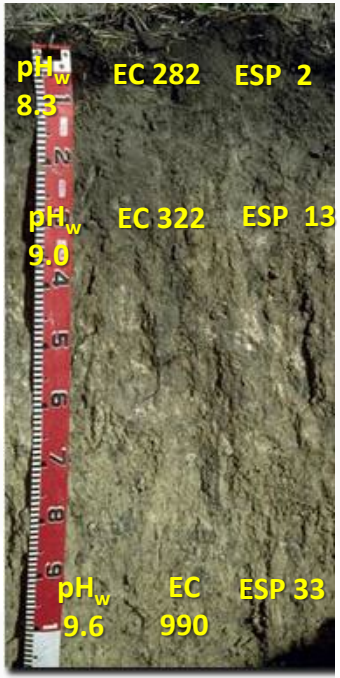
Percentage of the week where SWI >= 0.3 (Kiata, Wimmera)

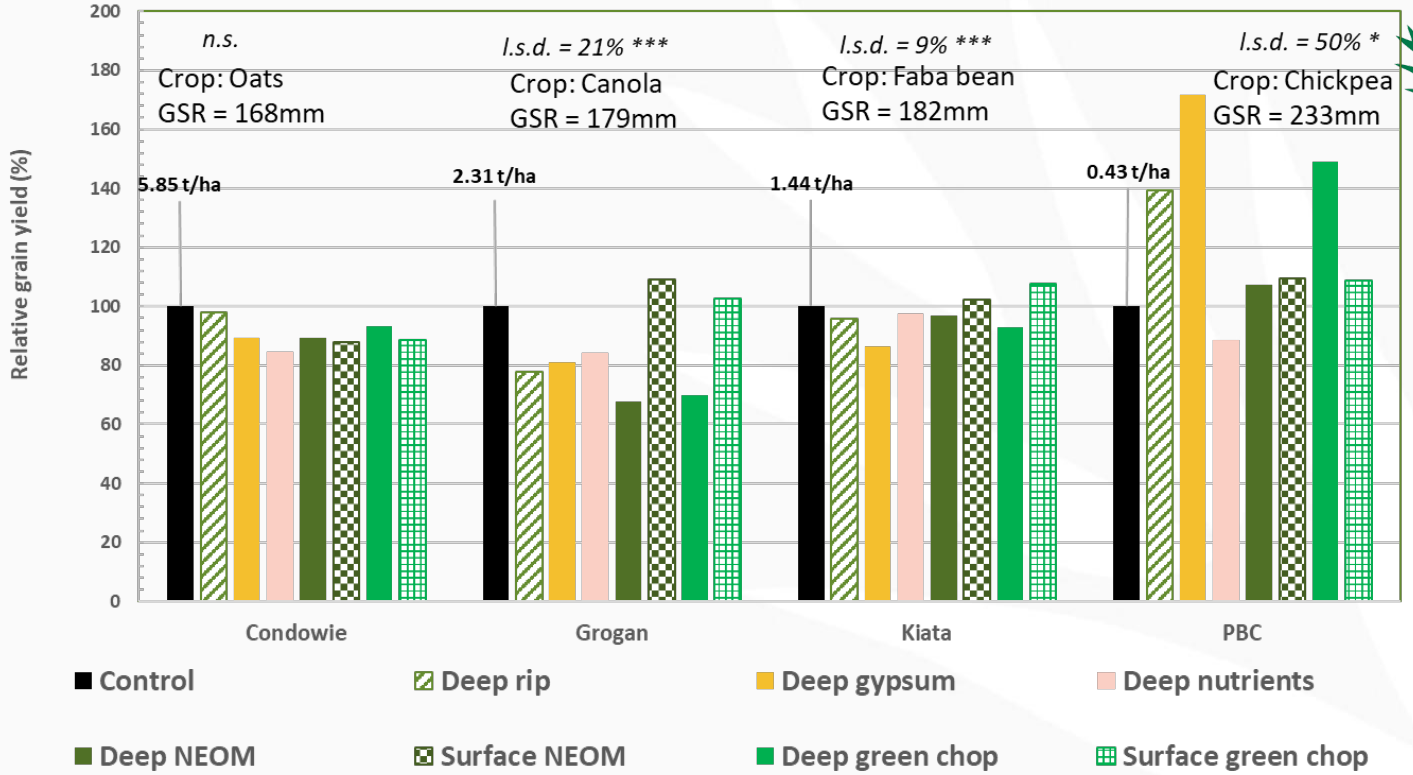


SWI (PWP – F.C.)

100% 80% 60% 40% 20% 0%

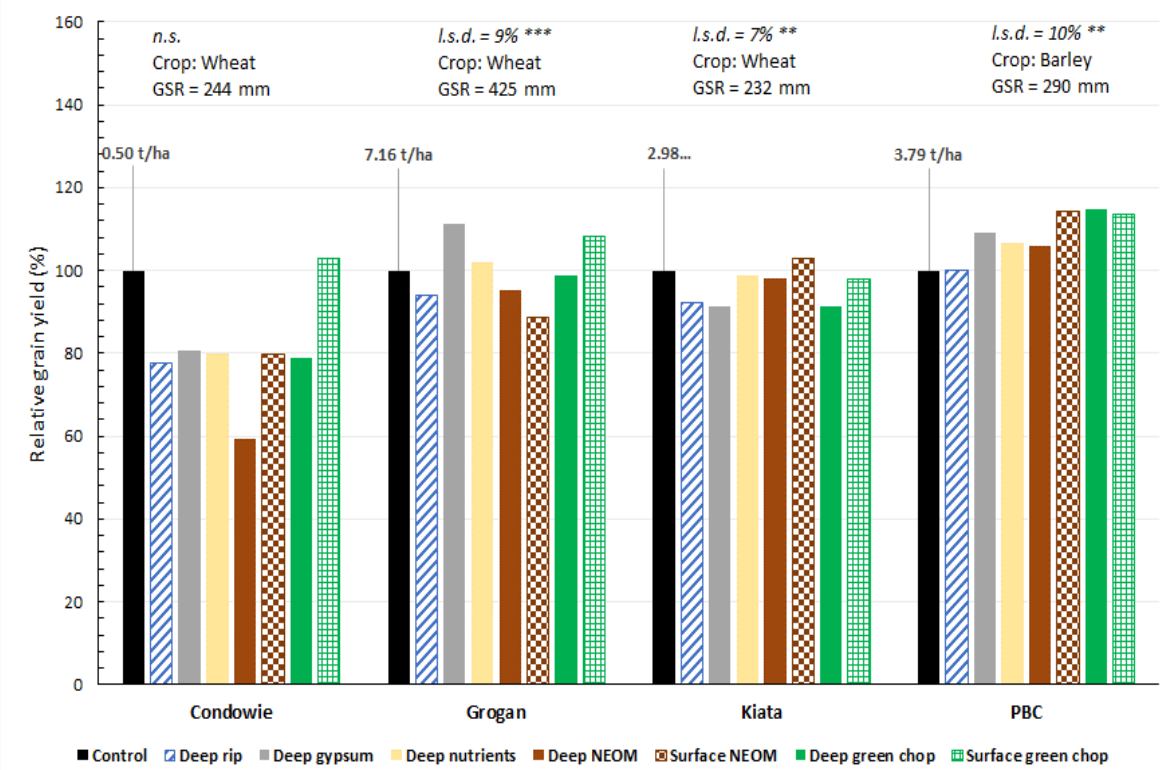
Kiata (Vertosol)





Relative grain yield response (%) of crops to different soil amelioration strategies with amendments applied either to the soil surface or subsoil (deep) at four sites in the MRZ (2019). GSR = growing season rainfall (mm).

'NEOM' = animal manure pellets; 'green chop' = lucerne or field pea hay pellets.

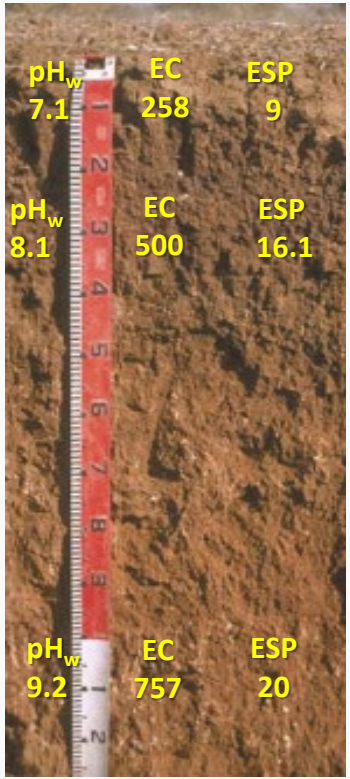


Relative grain yield response (%) of crops to different soil amelioration strategies with amendments applied either to the soil surface or subsoil (deep) at four sites in the MRZ (2020). GSR = growing season rainfall (mm). 'NEOM' = animal manure pellets; 'green chop' = lucerne or field pea hay pellets.

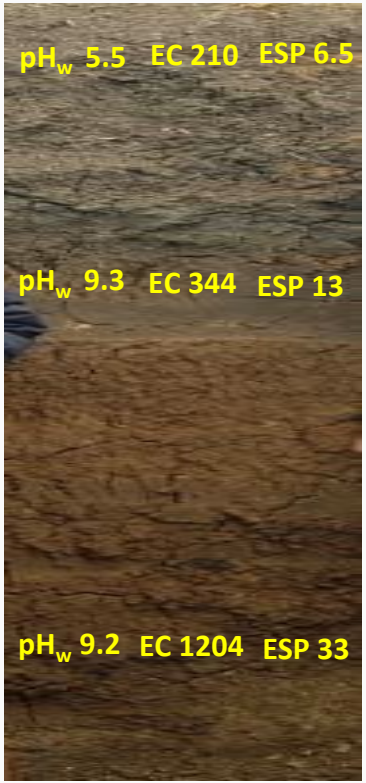
Location of constraints in the soil profile and depth of amelioration

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

Condowie (Red Sodosol)



Grogan (Sodosol)

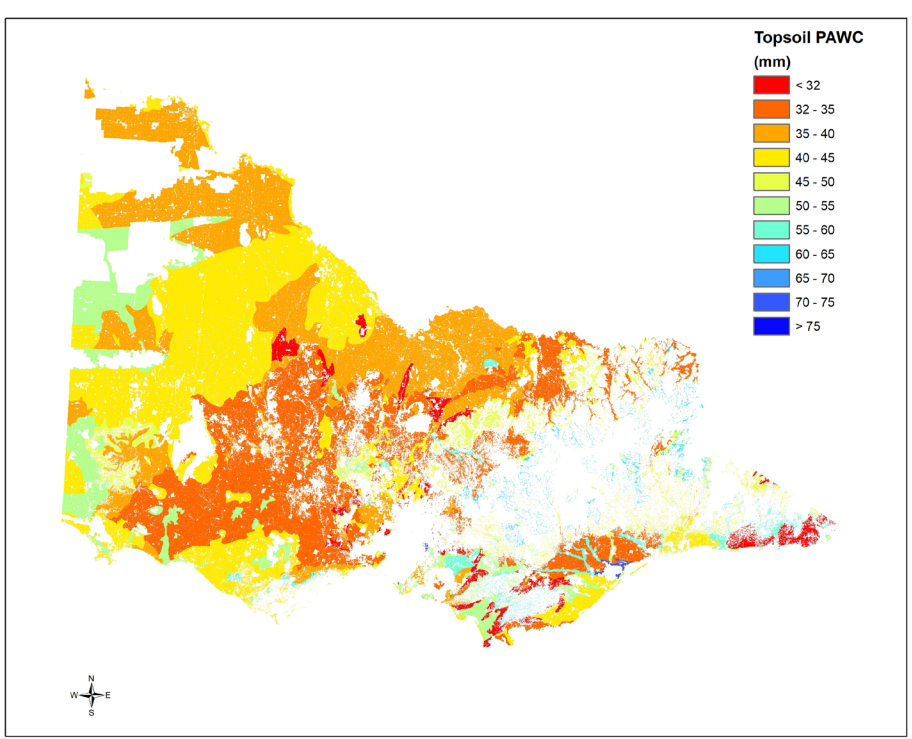


Kiata (Vertosol)

PBC (Vertosol)

Max. depth of amelioration

Where does the combination of rainfall and soil texture suggest that soil amelioration will potentially be worth trying?

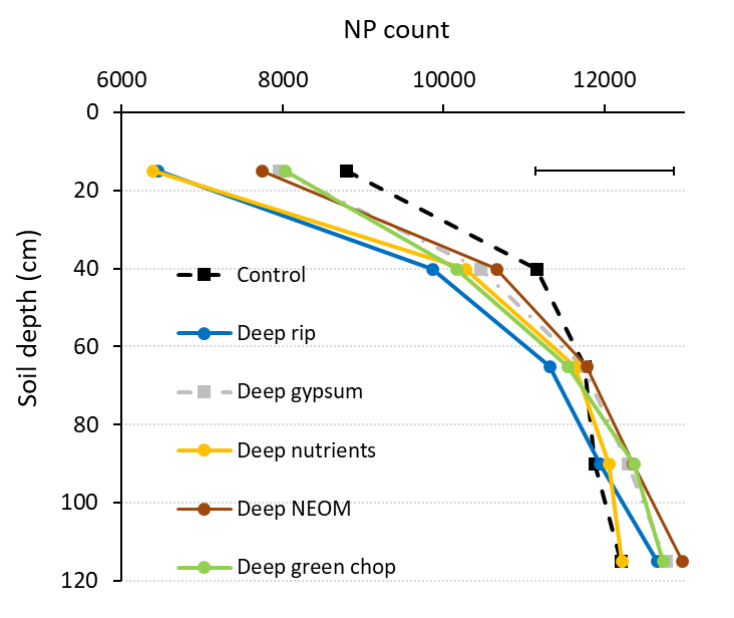


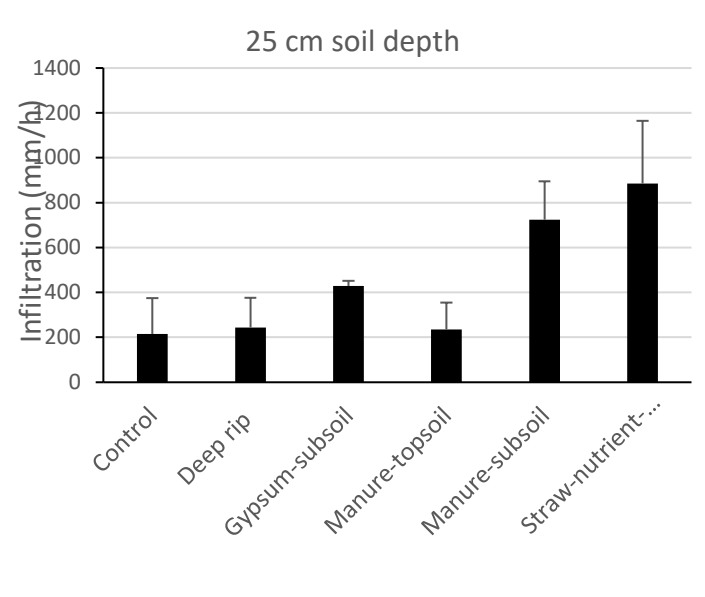
Australian Government

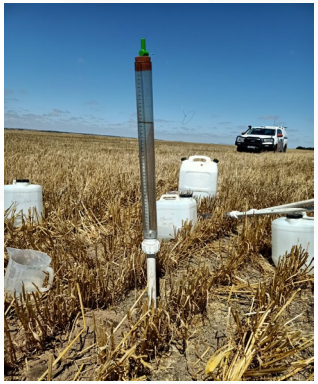
National Landcare Programme

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

Increasing the size of the bucket







GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

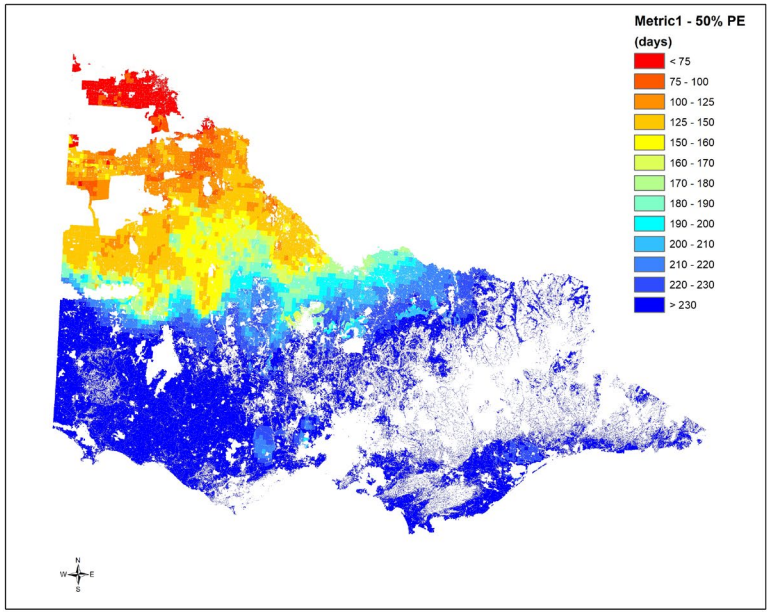
NSW GOVERNMENT Department of Primary Industries

LA TROBE UNIVERSITY

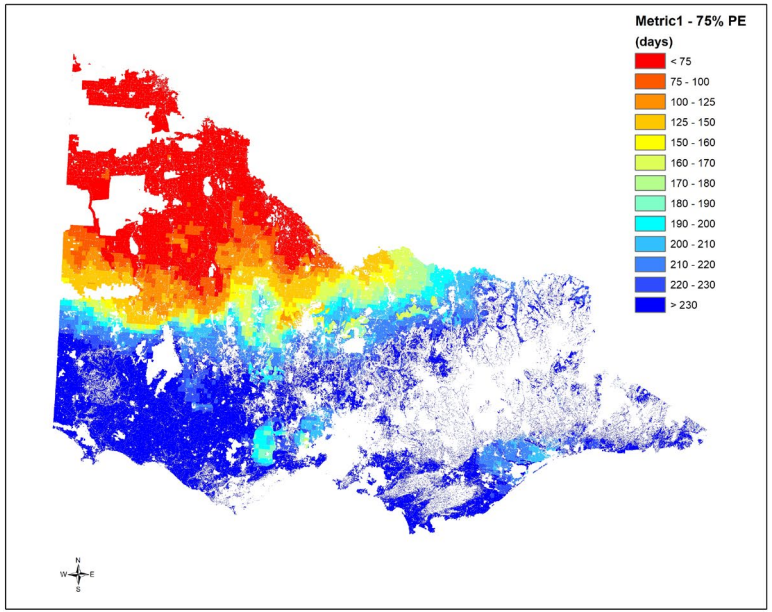
AGRICULTURE VICTORIA

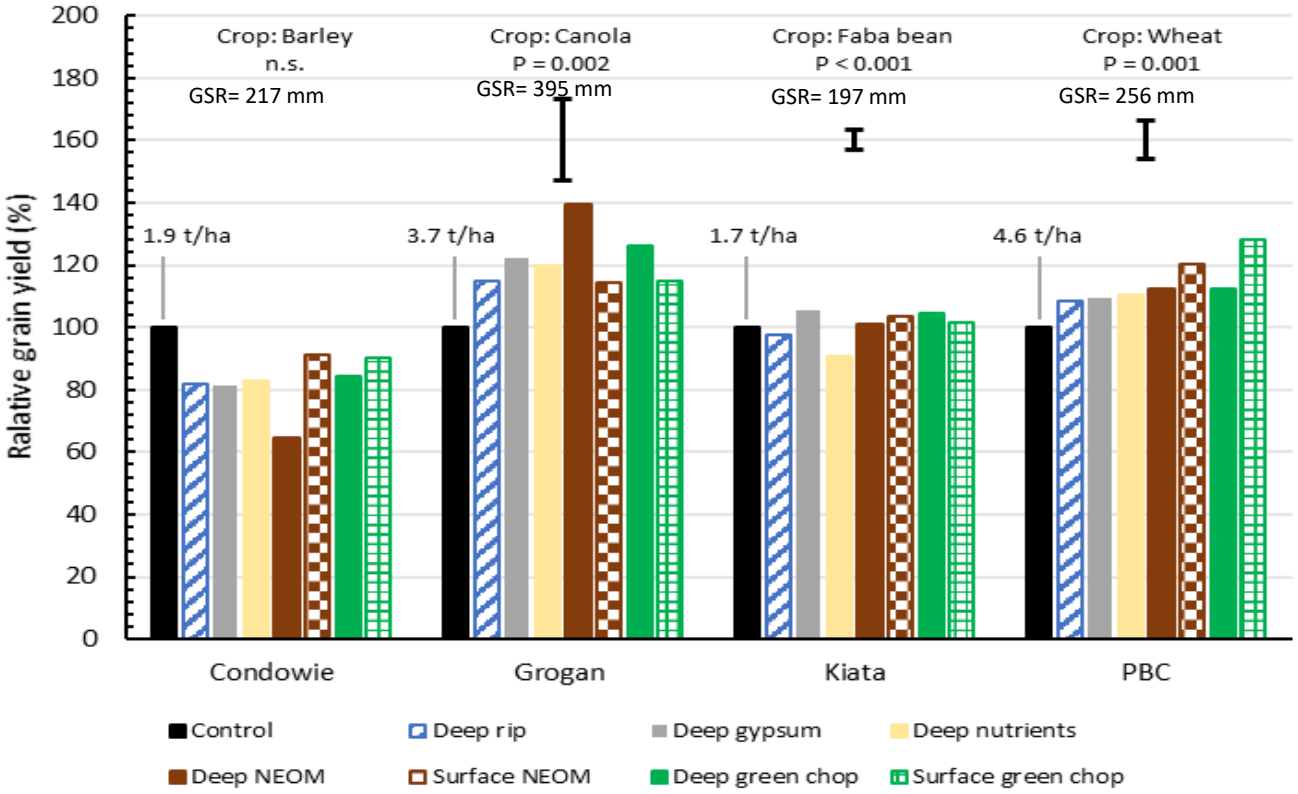
Probability of number of days exceeding critical soil water threshold (0.3 of available range) in the 20-40 cm layer

50 % Probability



75 % Probability





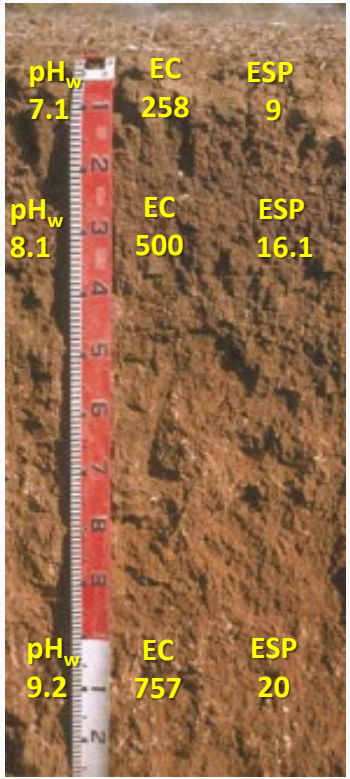
Relative grain yield response (%) of crops to different soil amelioration strategies with amendments applied either to the soil surface or subsoil (deep) at four sites in the MRZ (2021). GSR = growing season rainfall (mm).

'NEOM' = animal manure pellets; 'green chop' = lucerne or field pea hay pellets.

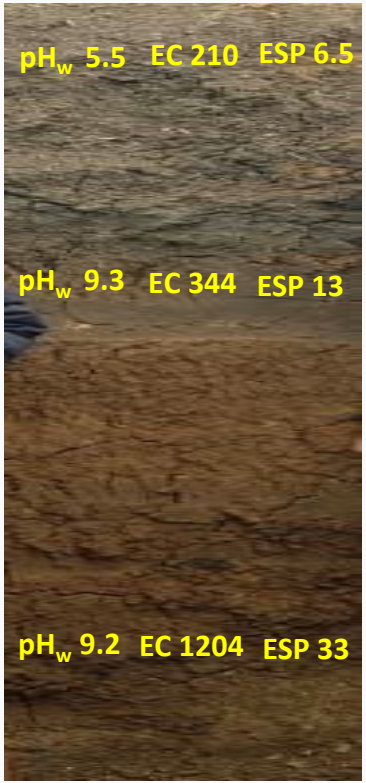
Location of constraints in the soil profile and depth of amelioration

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

Condowie (Red Sodosol)



Grogan (Sodosol)



Kiata (Vertosol)

Horsham (Vertosol)

Max. depth of amelioration