Transforming the productivity of sandy landscapes in southern and western Australia.

Therese McBeath, CSIRO
and
Stephen Davies, DPIRD

CSIRO

Department of Primary Industries and Regional Development
GOVERNMENT OF WESTERN AUSTRALIA

SANDY SOILS

GLOBAL CONFERENCE

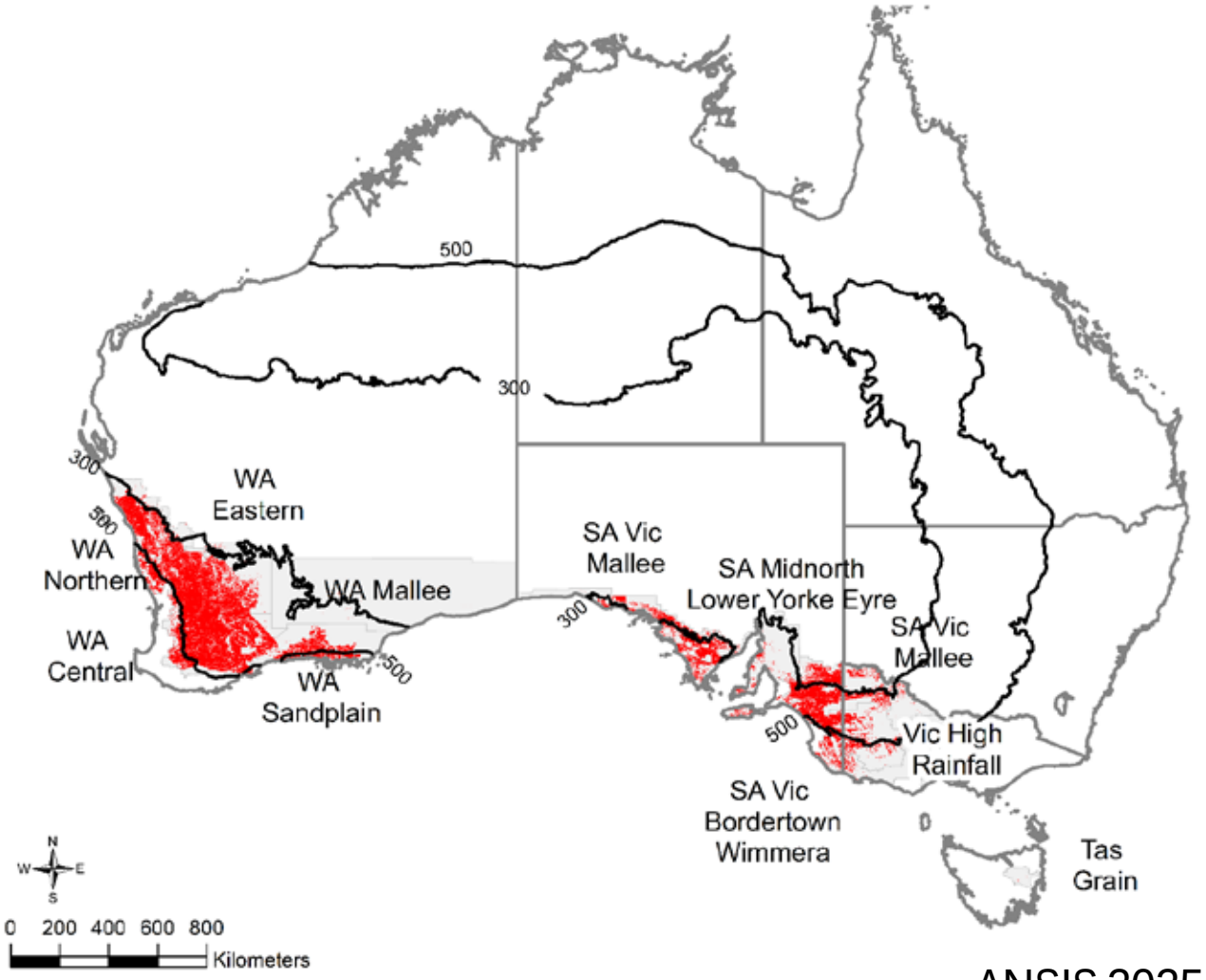
PERTH | AUSTRALIA | JULY 2025

Therese.Mcbeath@csiro.au Stephen.Davies@dpird.wa.gov.au

Sandy Soils of Agricultural Zones in Australia

Western

>20Mha of agricultural lands across Australia have >80% sand in the top 20cm.

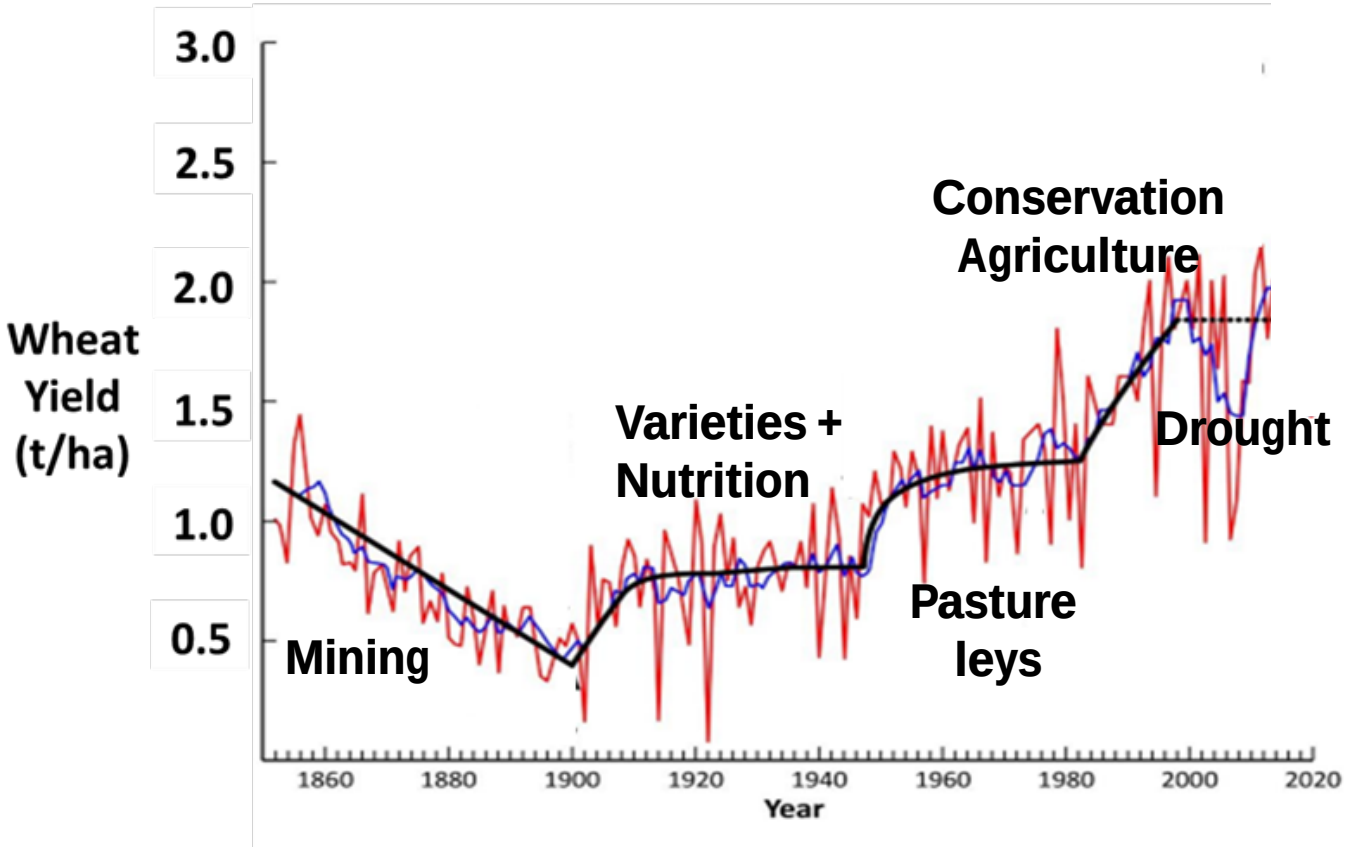


Southern

ANSIS 2025, drawn by J Ouzman

Where did we start?

Conservation Agriculture has been underpinning Australian grain production for decades...



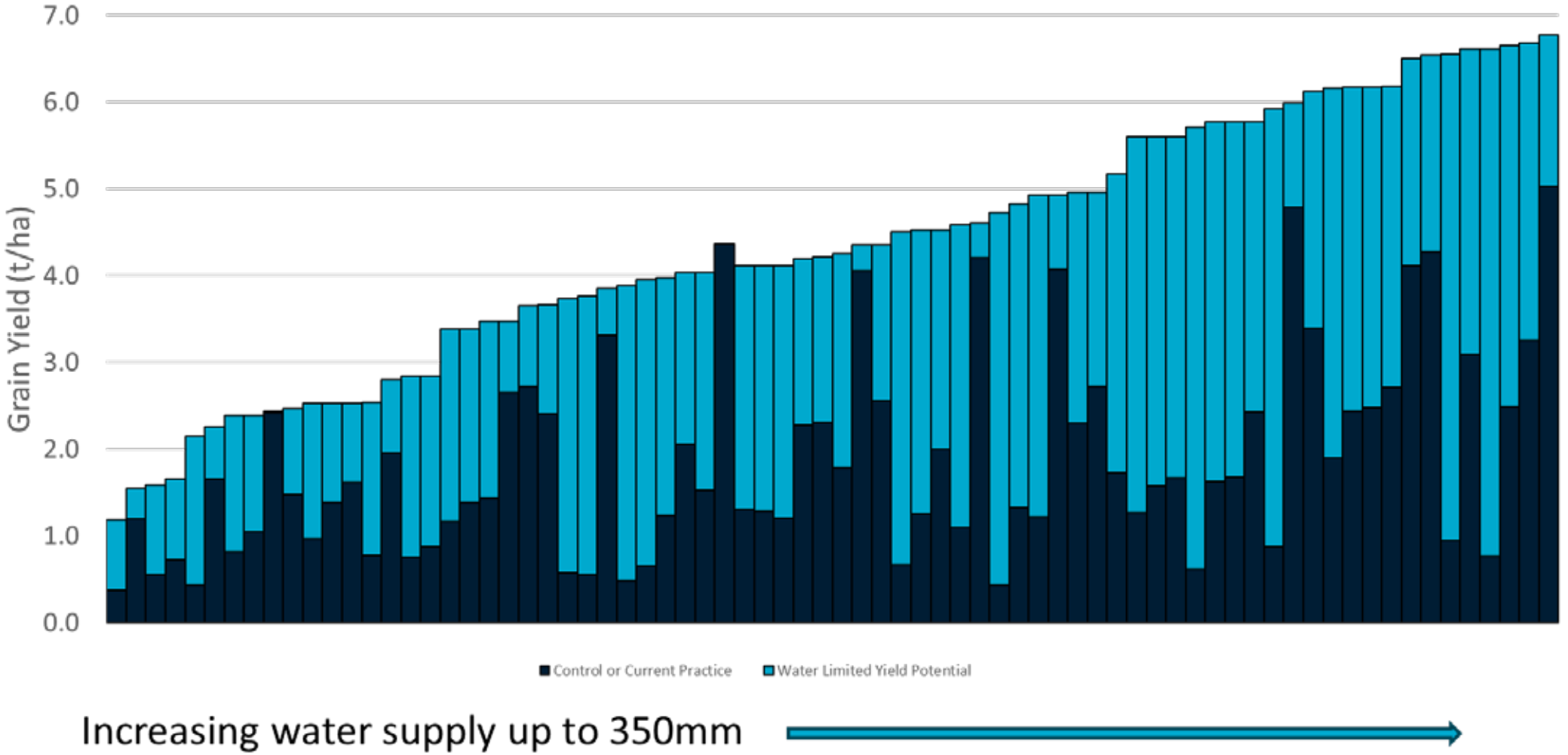
- By 2010, 90% of Australian growers had adopted no-till practices.
- In real terms wheat yields were not increasing following the millenium drought....
- The conservation agriculture system was facing a series of challenges....

Kirkegaard and Pratley, 2020

Where did we start?

Crops grown in sandy soils were underperforming relative to potential. This was evidenced by:

- Water left behind at harvest.
- A gap between actual and potential yield ~55%.



Southern project sites 2016-2022, Porker et al. 2025.

Sandy Soil – Constraints to Crop Production

Repellence

- Coating of low surface area sand particles with waxy, organic materials.
- Often derived from crop residues.
- Poor infiltration and crop establishment.

Acidity

- Low buffering soils.
- Vulnerable to loss of bases as crop production increases.
- Increased use of N fertiliser increases acidification rate.
- Poor growth of susceptible crops/ varieties.

M.Fraser

Fertility

- Low organic matter soils, with low inherent fertility.
- Low cation exchange and buffering capacity.
- Often have bleached layers and a history of nutrient removal > inputs.
- Poor growth and water use.


B.Masters

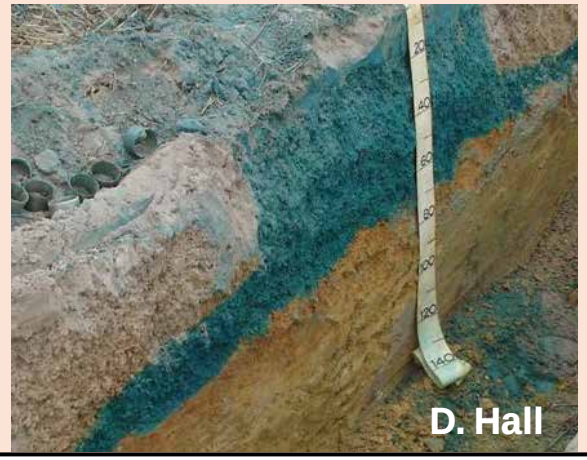
Sandy Soil Constraints to Crop Production

Soil Strength

- Traffic induced compaction
- Natural hardening on drying
- Cementing
- Reduced root growth (depth and volume)

Water Holding Capacity

- Low capacity to store moisture.
- Water vulnerable to rapid infiltration and movement.
- Can be a benefit (less rain to wet up to available water content)!



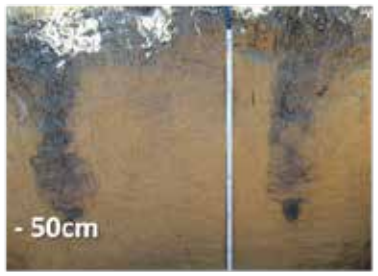
Therese.Mcbeath@csiro.au Stephen.Davies@dpird.wa.gov.au

Strategic Deep Tillage Options

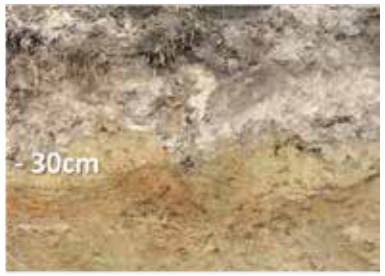
Deep Ripping

Shatter

Topsoil Inclusion



Clay Delving



Shatter and Redistribute (send down/ bring up)

Rotary Spading

One Way Plough

Mouldboard Plough

Mix and Dilute

Invert

Strategic Tillage Benefits

Overcoming soil Constraints

1. Burial/dilution of water repellent topsoil
2. Incorporation of:
    i. Lime
    ii. Organic matter
    iii. Biology
    iv. Nutrients
    v. Clay
3. Soil loosening to working depth of implement

Other Benefits

1. Root growth
2. Weed seed burial
3. Increased activity of soil applied herbicides
4. Increased biological activity to incorporation depth
5. Reduced *Rhizoctonia solani* AG8 damage
6. Reduced frost damage

Strategic Tillage Risks

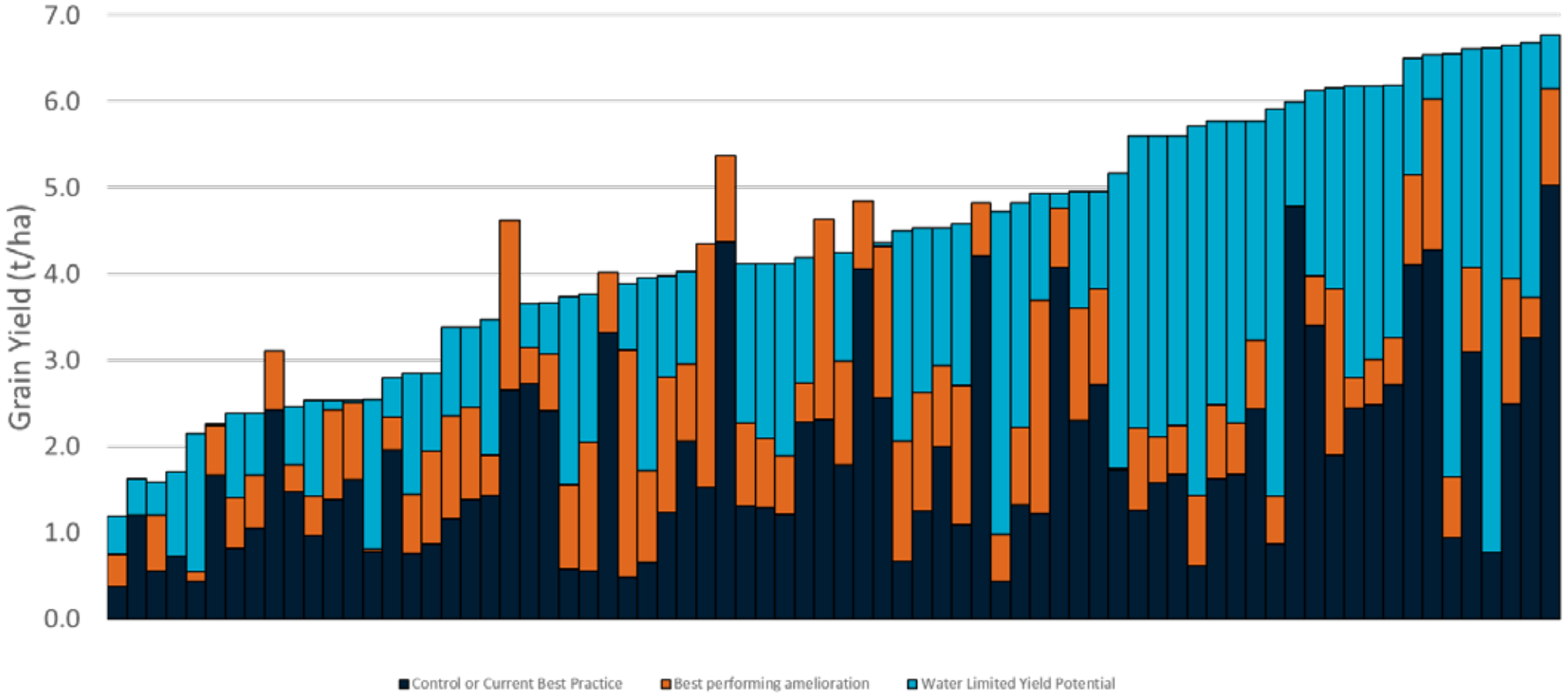
Crop Establishment Risks

1. Seeding depth/placement
2. Furrow infill – wind erosion
3. Herbicide damage
4. Soil crusting
5. Rapid soil drying

Other Risks

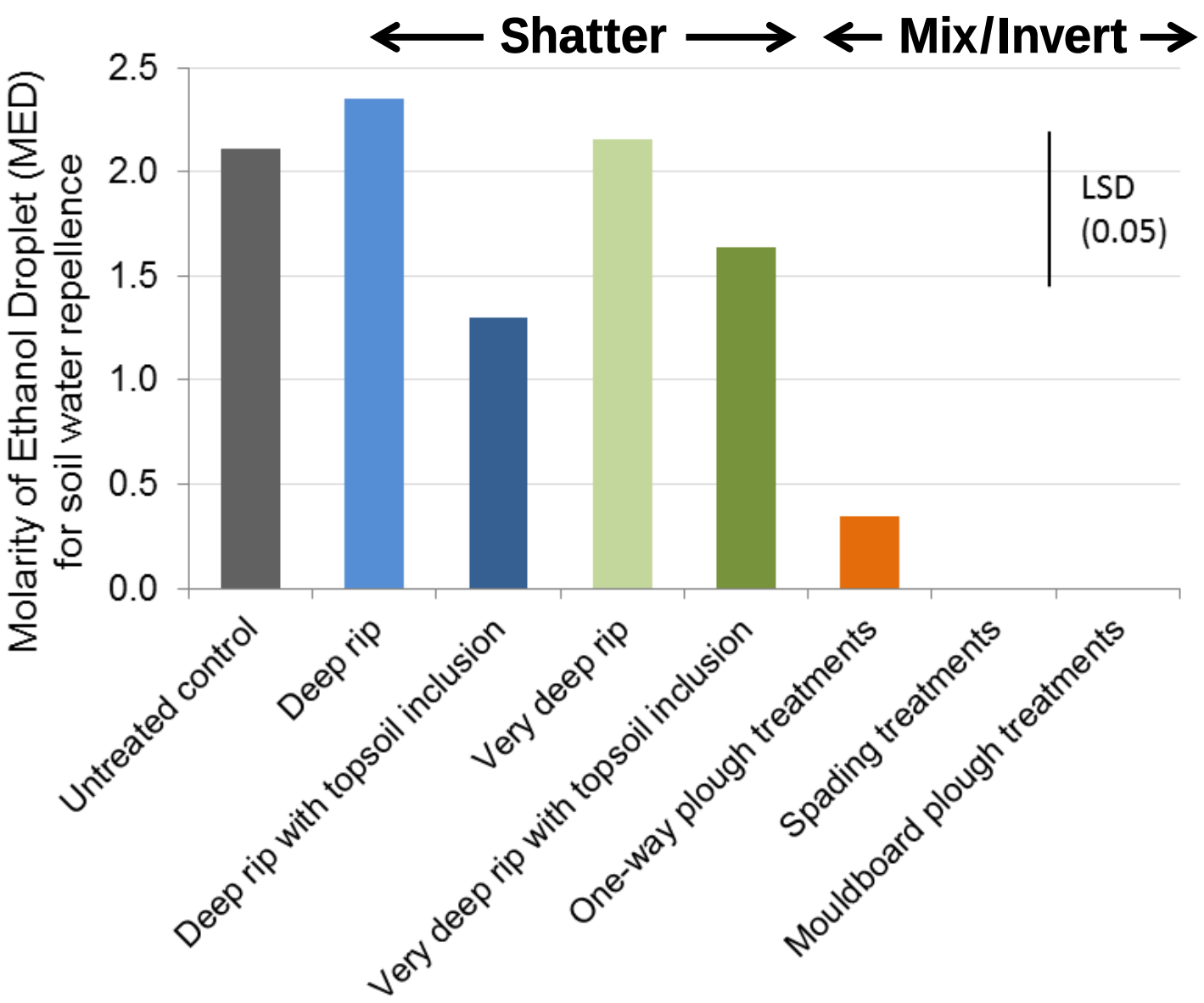
1. Trafficability
2. Soil erosion
3. Low topsoil OM
4. Soil C loss
5. Re-compaction
6. Haying off

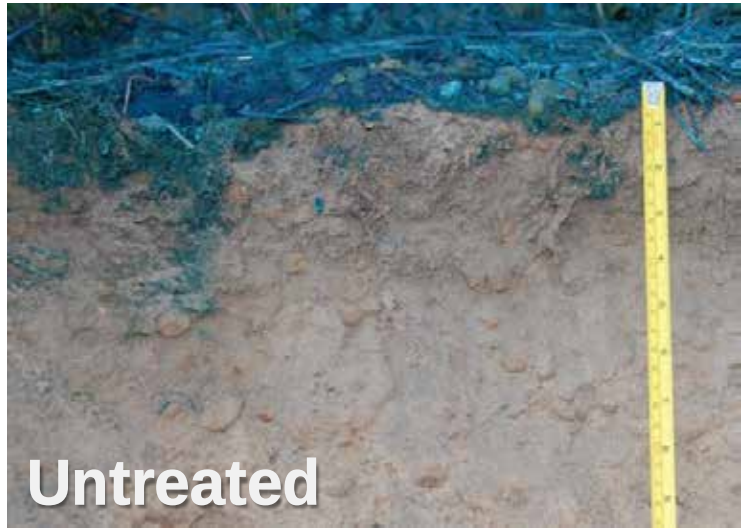
Strategic Tillage Responses

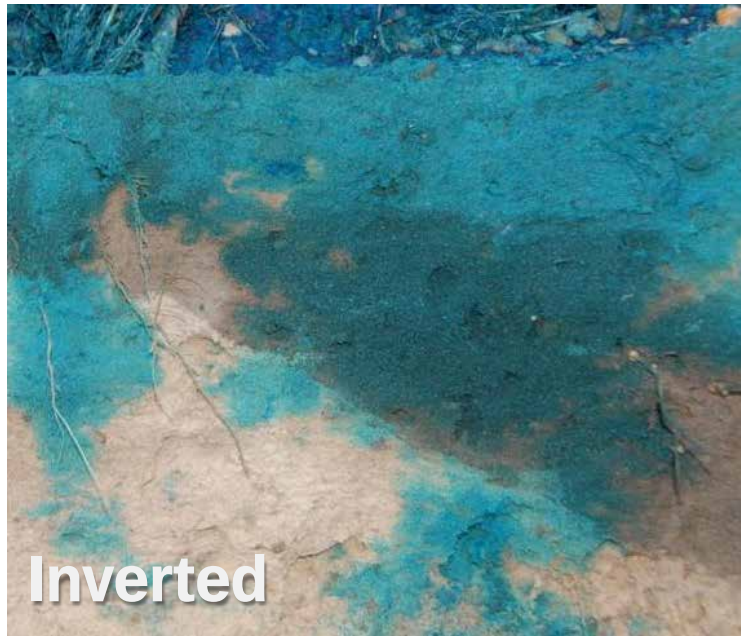


On average, 36% of yield gap closed.
In some cases, gap is closed and potential exceeded
Southern project sites 2016-2022, Porker et al. 2025.

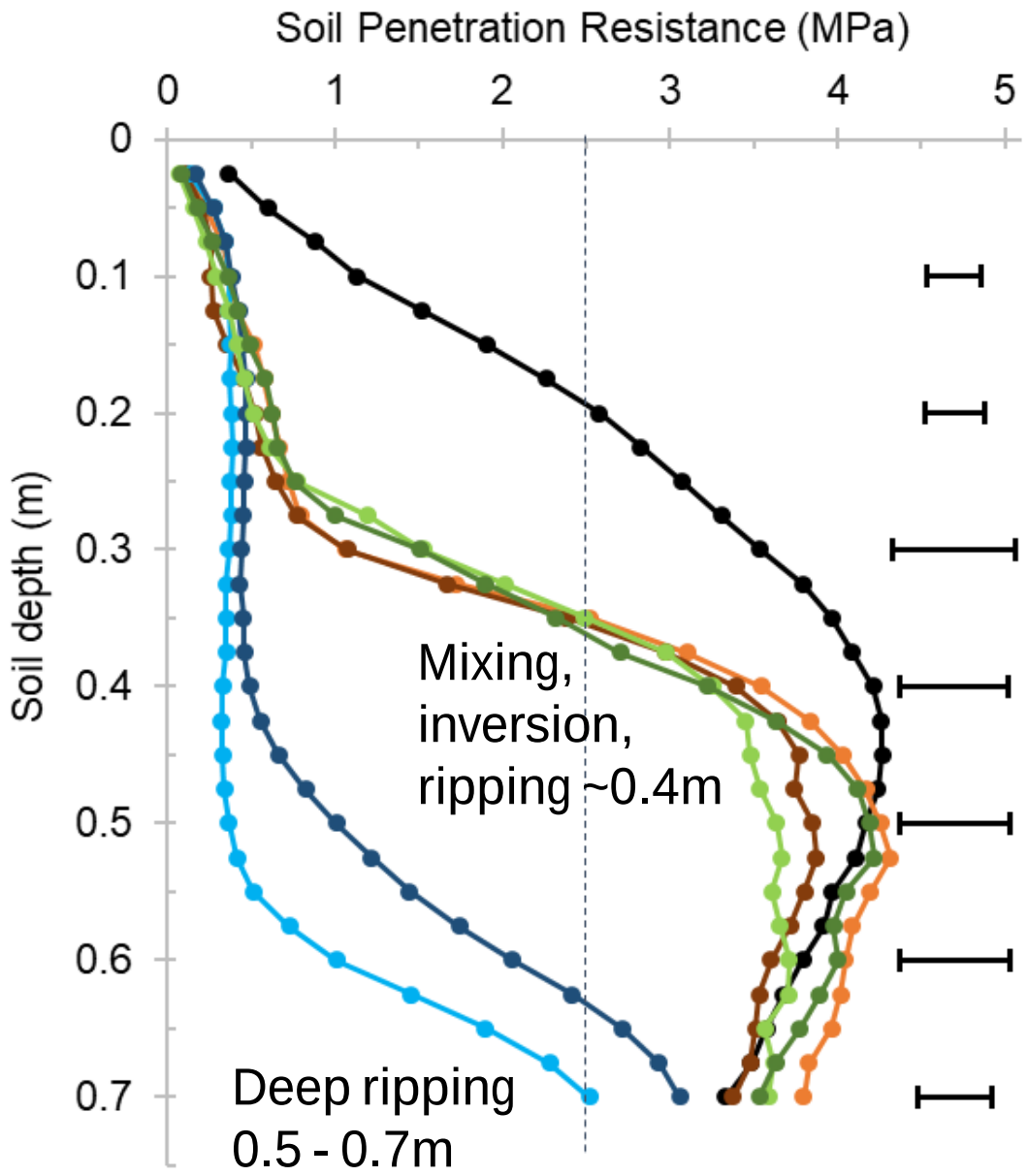
Strategic Tillage – Topsoil Water Repellence

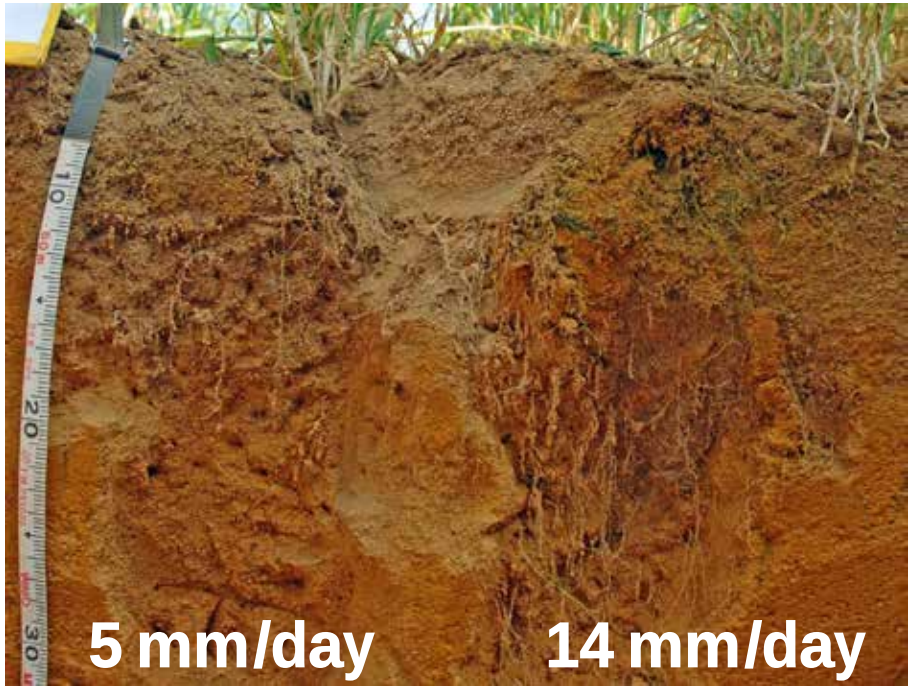






Strategic Tillage – Soil Strength





Strategic Tillage – Soil Acidity

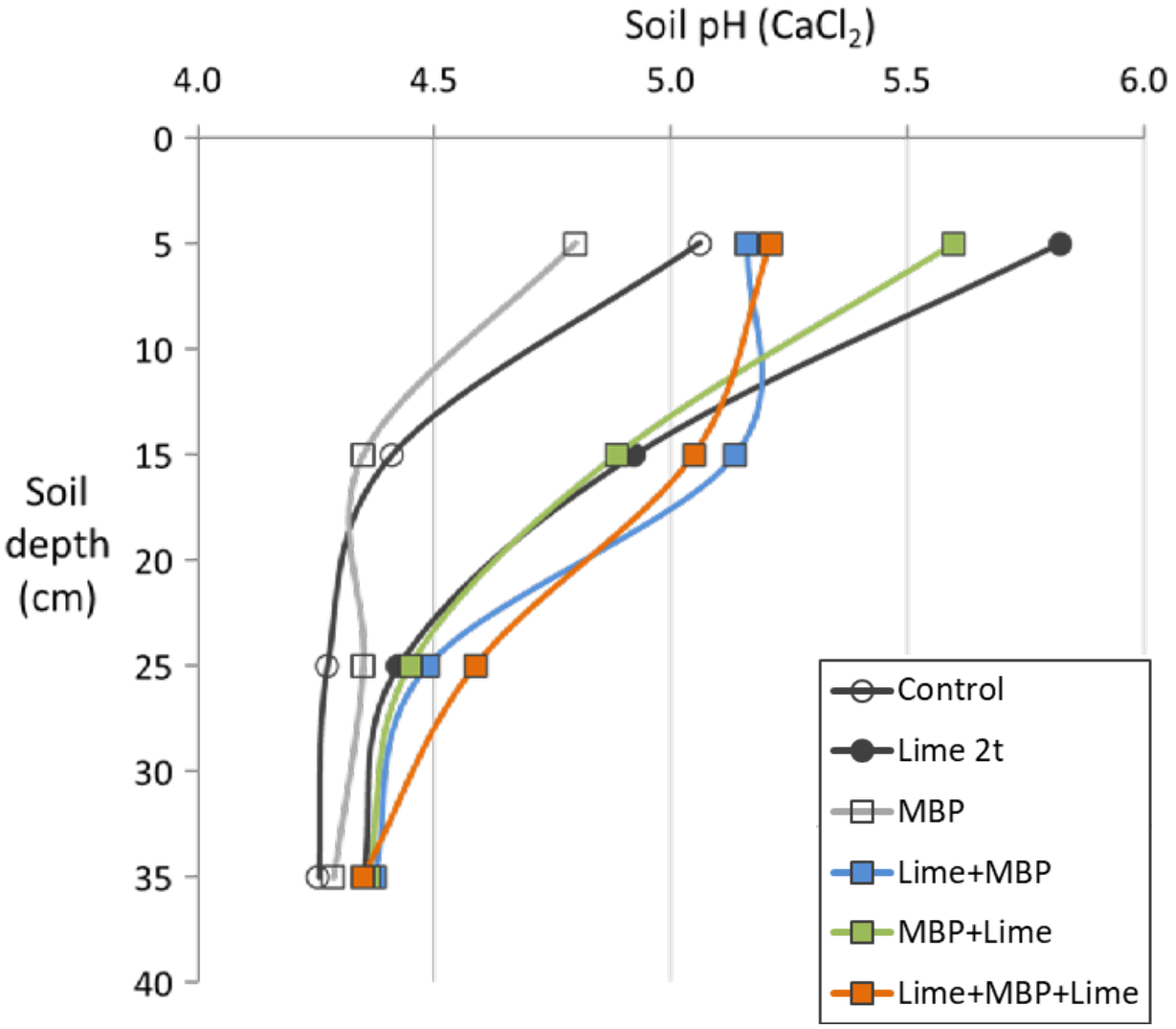
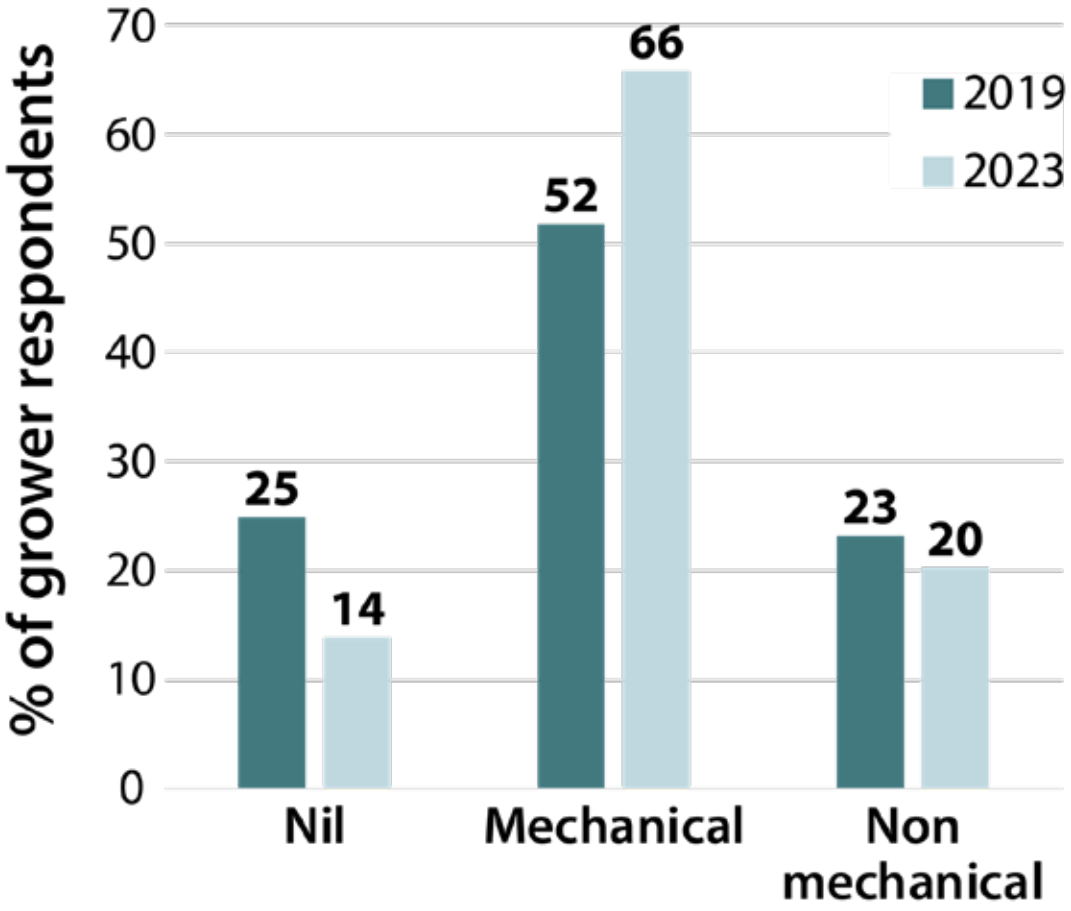


Photo: C. Gazey

Strategic Tillage Adoption



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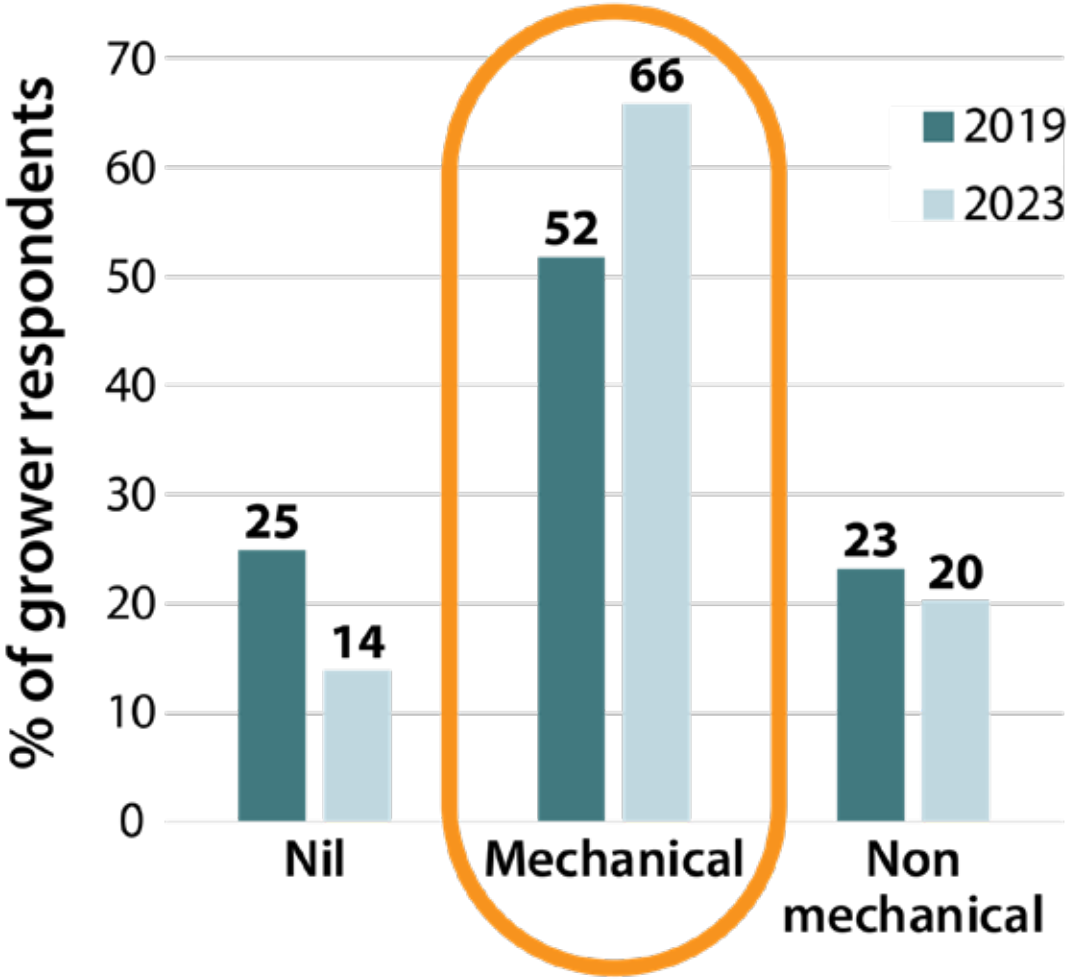
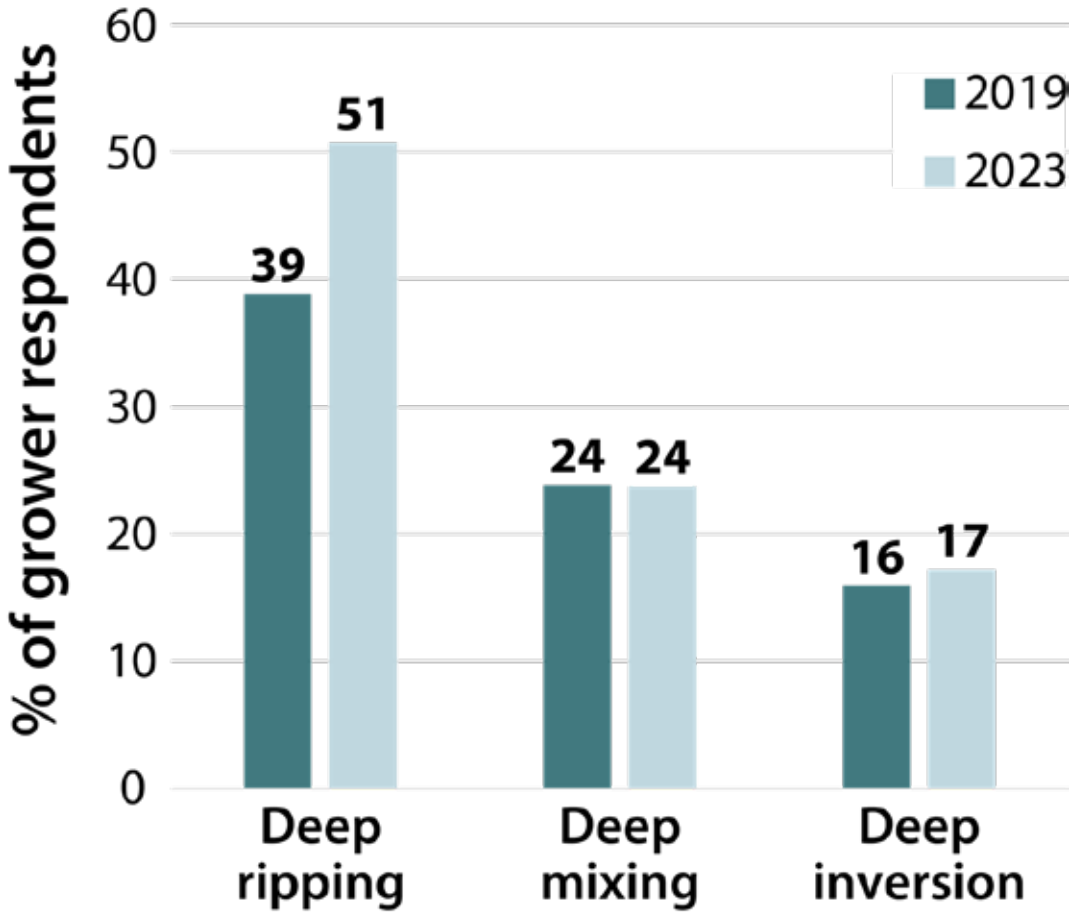
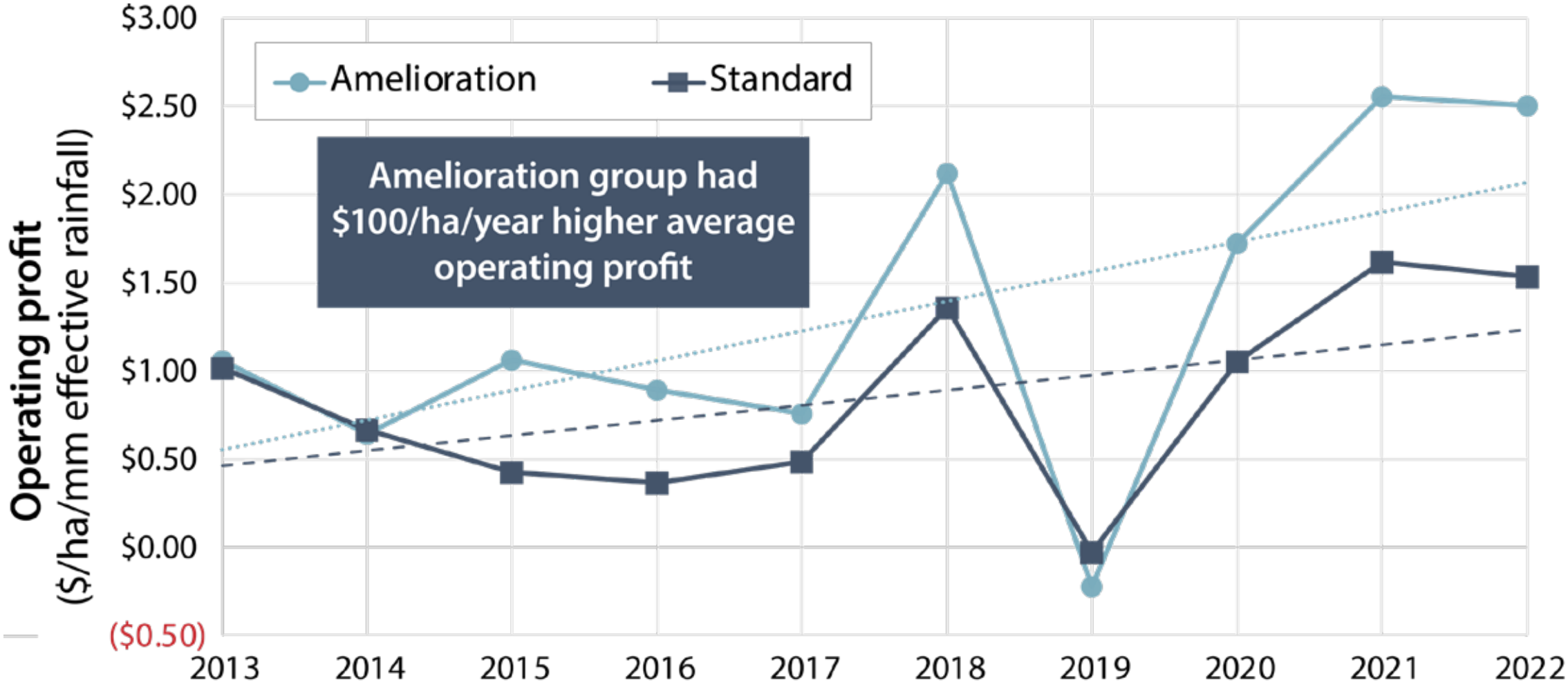




Strategic Tillage Economics



Conclusions

- Sandy soils of Australia have multiple constraints to crop production.
- Strategic deep tillage ameliorates the constraints when the tillage technique is matched to the constraint.
- Adoption of strategic deep tillage has been rapid, but risks need to be managed to fully realise the benefits.
- Strategic tillage – an important tool for sustaining our conservation agriculture systems.

Therese.Mcbeath@csiro.au Stephen.Davies@dpird.wa.gov.au

Acknowledgements

Thanks to:

- Our collaborating researchers in the project teams
- GRDC Projects
  - SOUTH: CSP2403-017RTX, CSP002003
  - WEST: DAW2407-001SPX, DAW1901-006RTX, DAW1902-003RTX, DAW1801-001RTX
- Our Collaborating Landholders and wonderful technical teams.

Therese.Mcbeath@csiro.au Stephen.Davies@dpird.wa.gov.au