



# Towards long hypocotyl canola with improved establishment potential

## National Canola Pathology Workshop

Matthew Nelson and the CSIRO team | 8 March 2023

Australia's National Science Agency



**GRDC**<sup>™</sup>  
GRAINS RESEARCH  
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50%



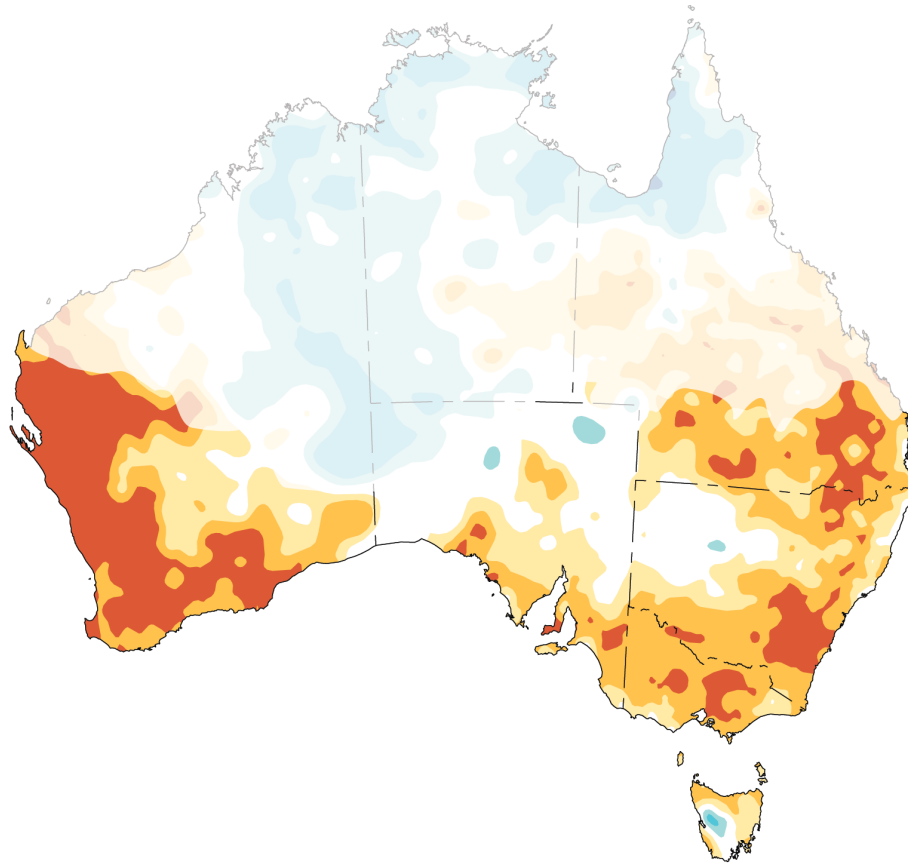
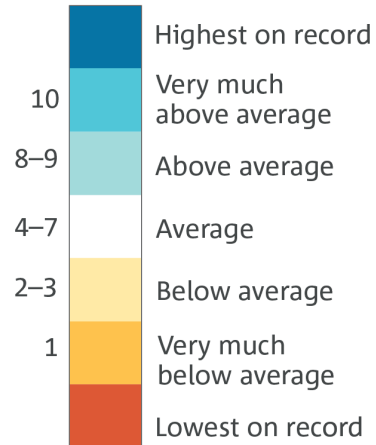
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Canola establishment is unreliable in Australia

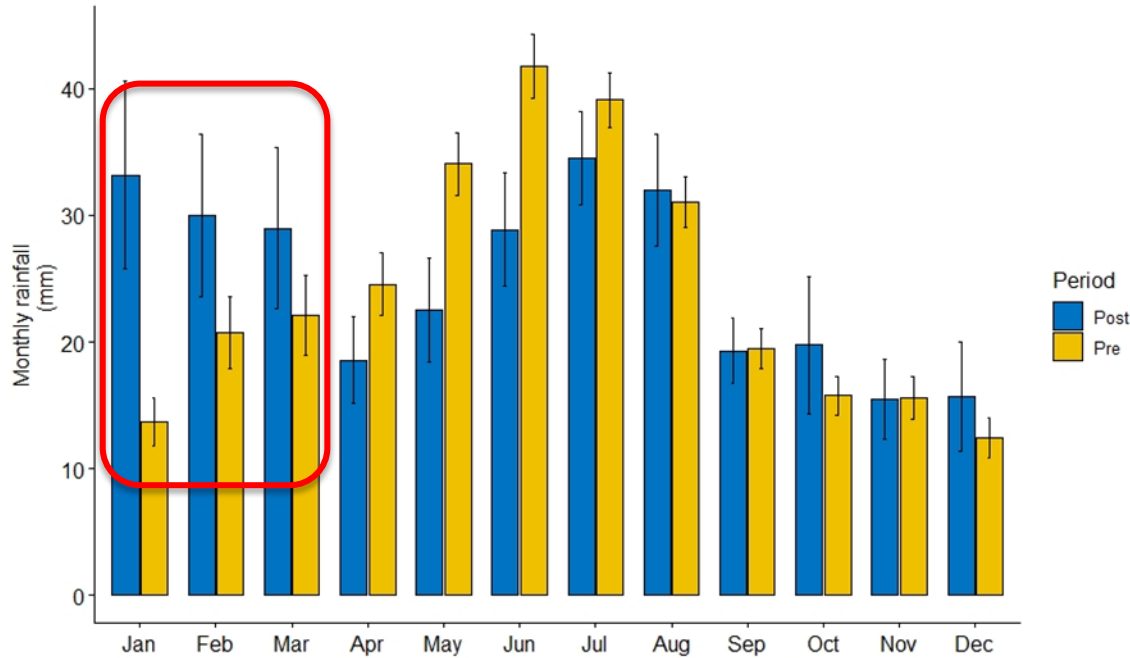
# April-October rainfall over the past ~20 years

## Rainfall decile ranges



Source: Bureau of Meteorology

# Changes in long-term monthly average rainfall for Southern Cross (WA) (pre-2000 and post-2000)

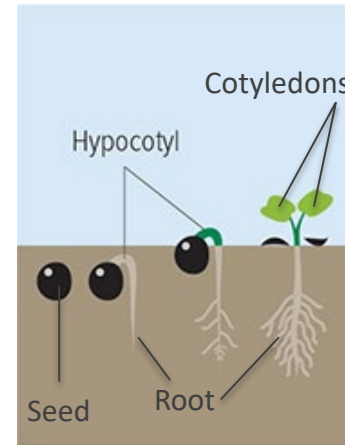


Deep-sowing canola would allow better access to stored soil moisture



# Canola struggles to emerge from deep sowing

	Canola	Wheat
Seed size	2-4 mg	35-50 mg
Seed composition	Mostly oil	Mostly starch
Germination	Epigeal	Hypogeal



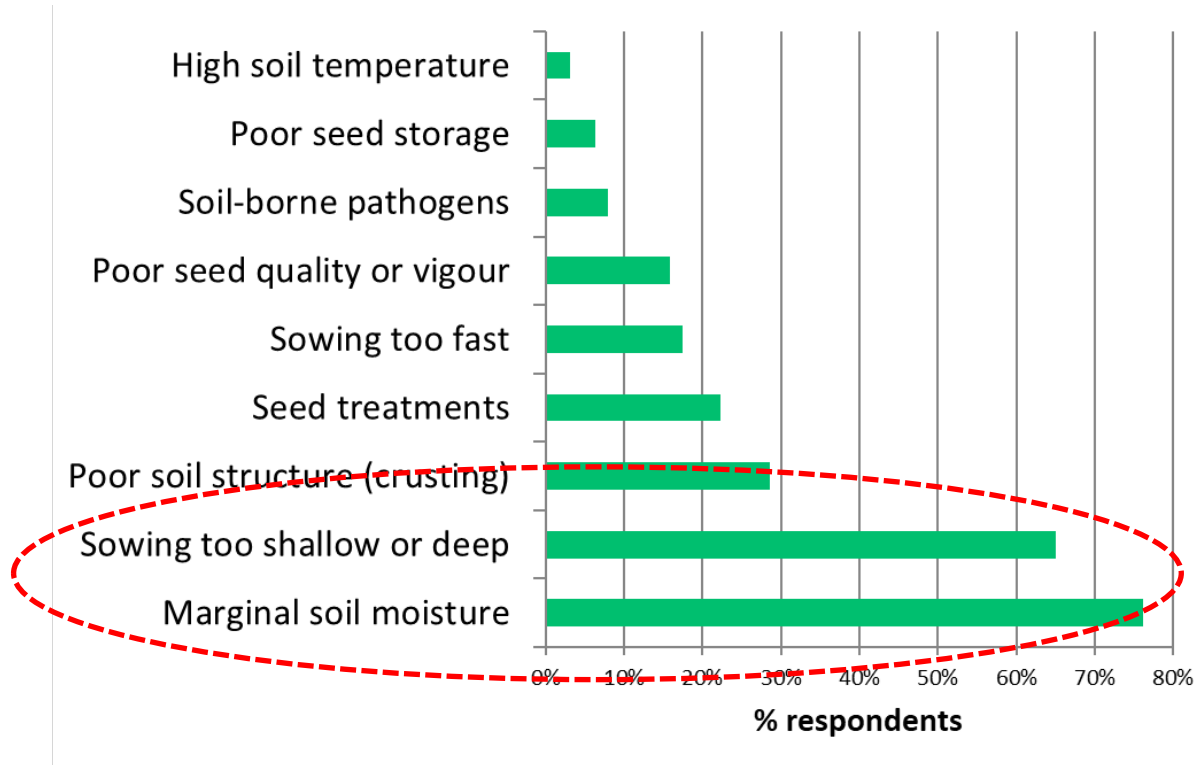
Canola



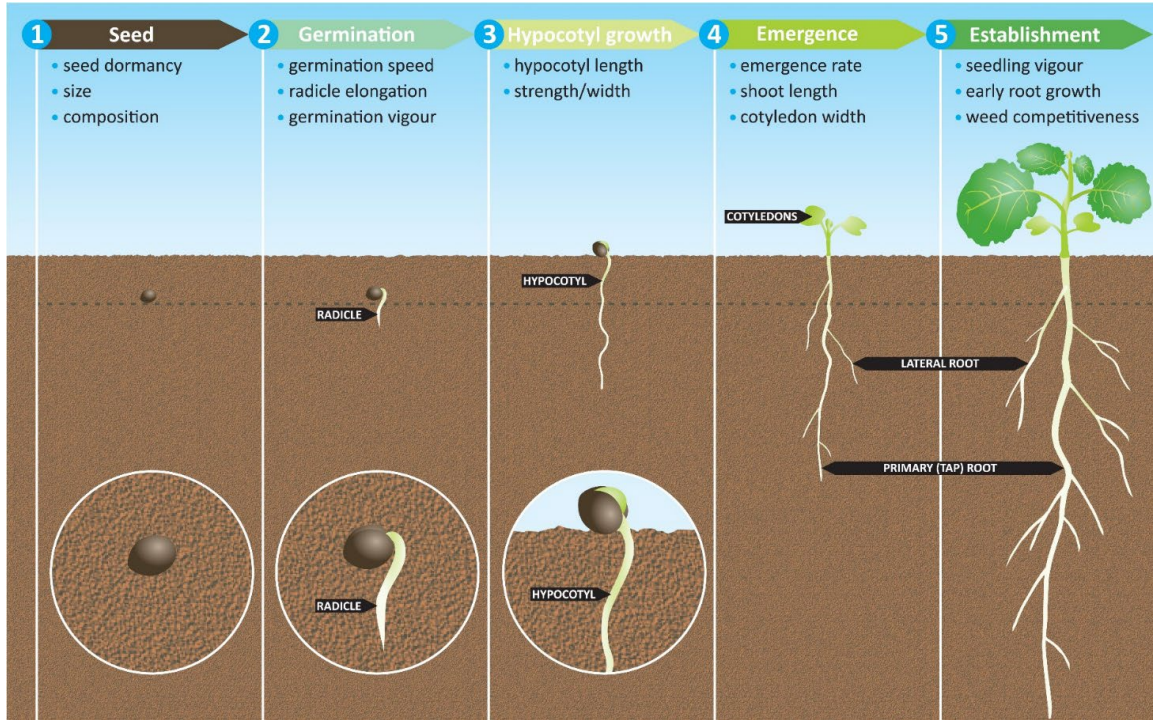
Wheat

# Industry survey: Causes of poor establishment

63 growers/agronomists, January 2020



# Breeding targets for improved establishment



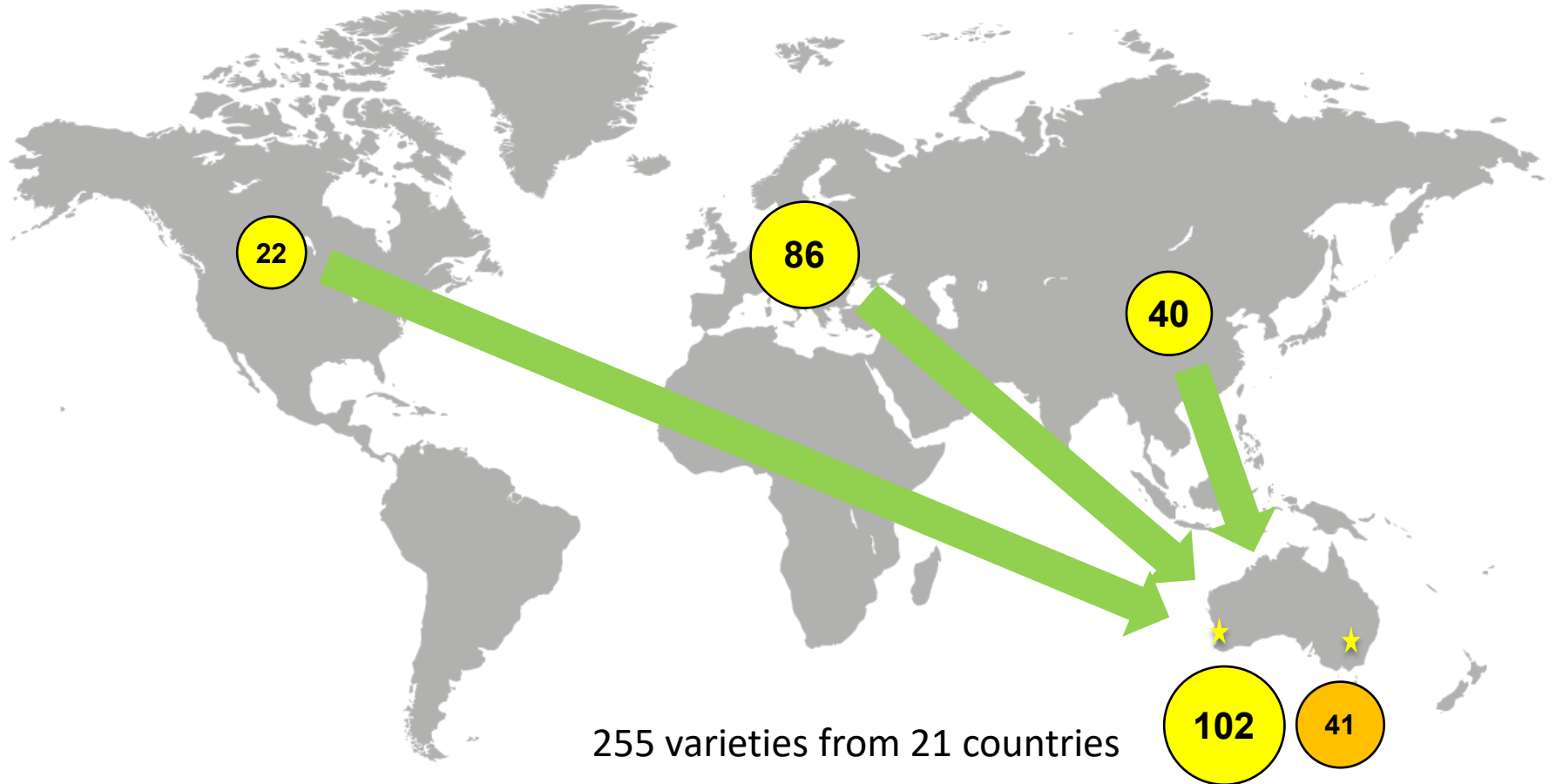
- Long hypocotyls for improved emergence from deep sowing
- Enhanced early vigour to chase moisture, emerge quickly and form a canola early



# Assembling diverse germplasm



# Tapping into global canola diversity



# Minimising seed-lot effects in a common garden nursery

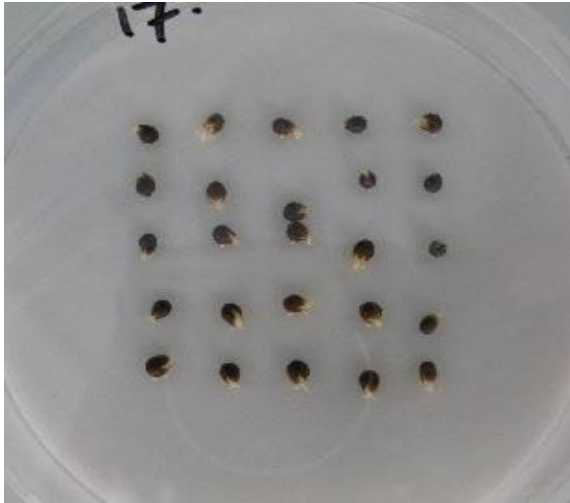




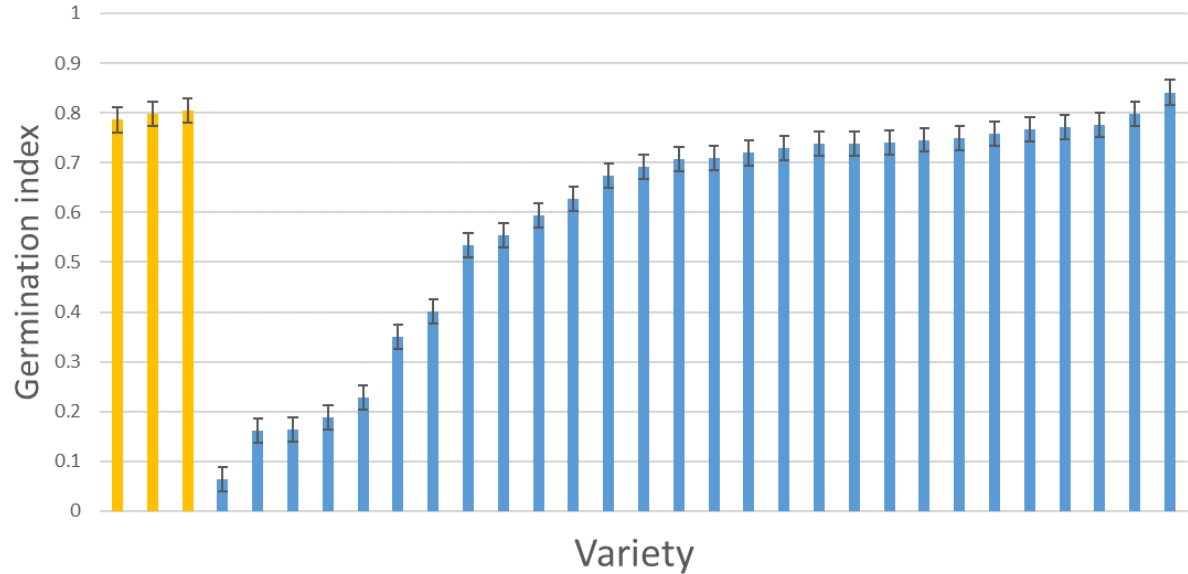
# Phenotypic selection tools

# Seed vigour

Germination Index, GI



- 10 °C in darkness
- Score daily for 7d



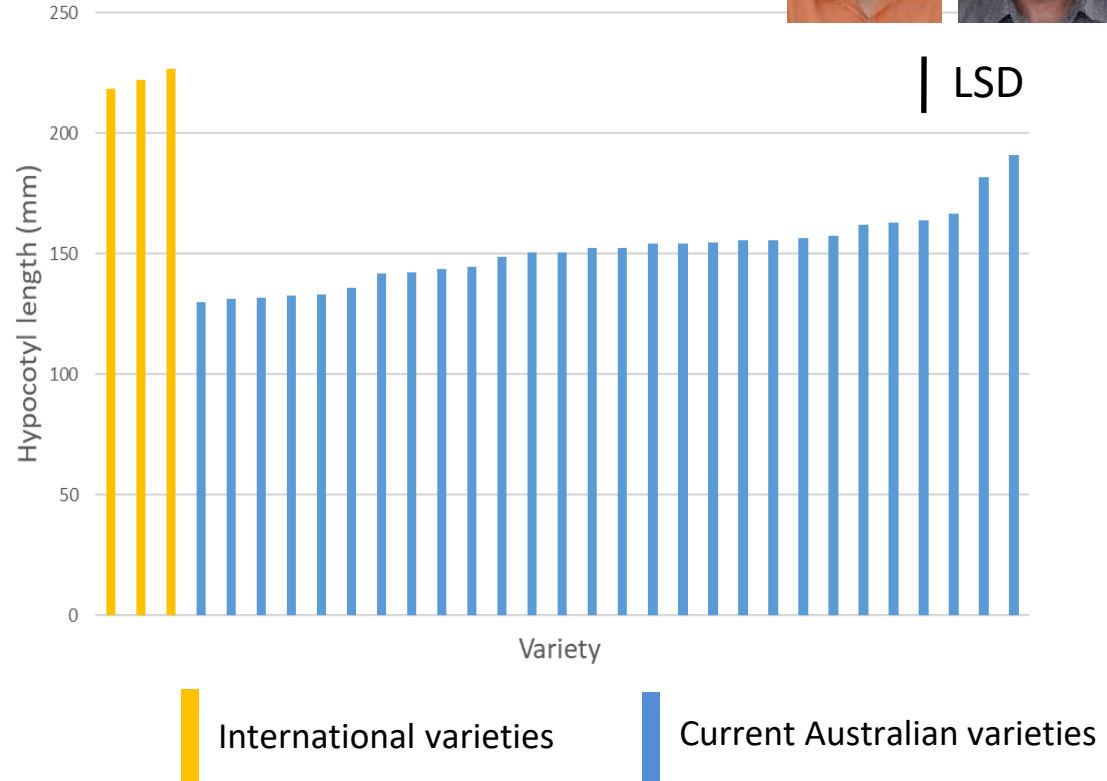
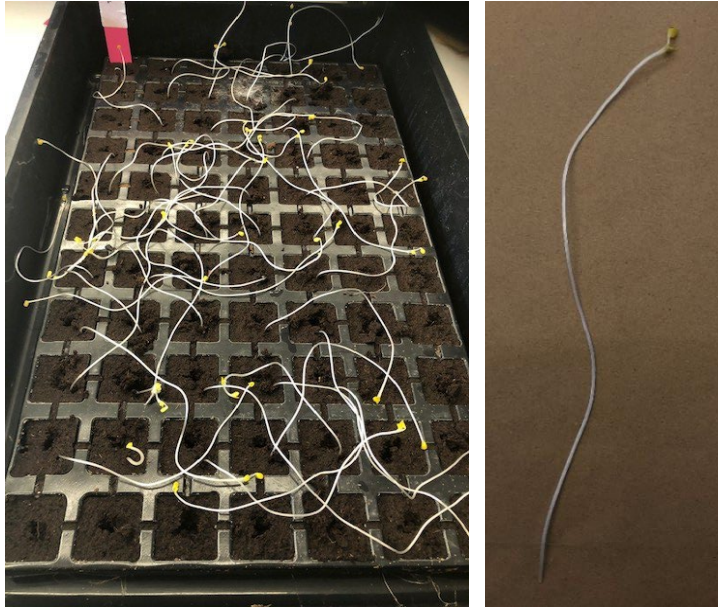
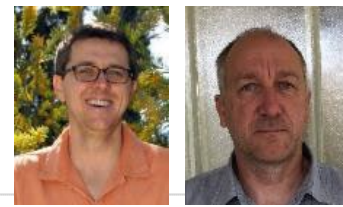
International OP varieties



Current Australian varieties



# Hypocotyl length



- Individual seeds weighed
- Grow in dark for 230 °Cd



But will it hold  
up in the field?



# Validating traits in the field

# Validating lab-measured traits in the field

Eight field sites in WA and NSW in 2021 and 2022



- 3000 seeds per site hand-sown at 20mm and 50mm depths
- 20 international varieties (same seed source, same size)
- 5 current Australian varieties
- Regular emergence counts
- Final biomass at 4-leaf stage



Best  
Australian  
variety



20 mm

50 mm

Best  
international  
variety

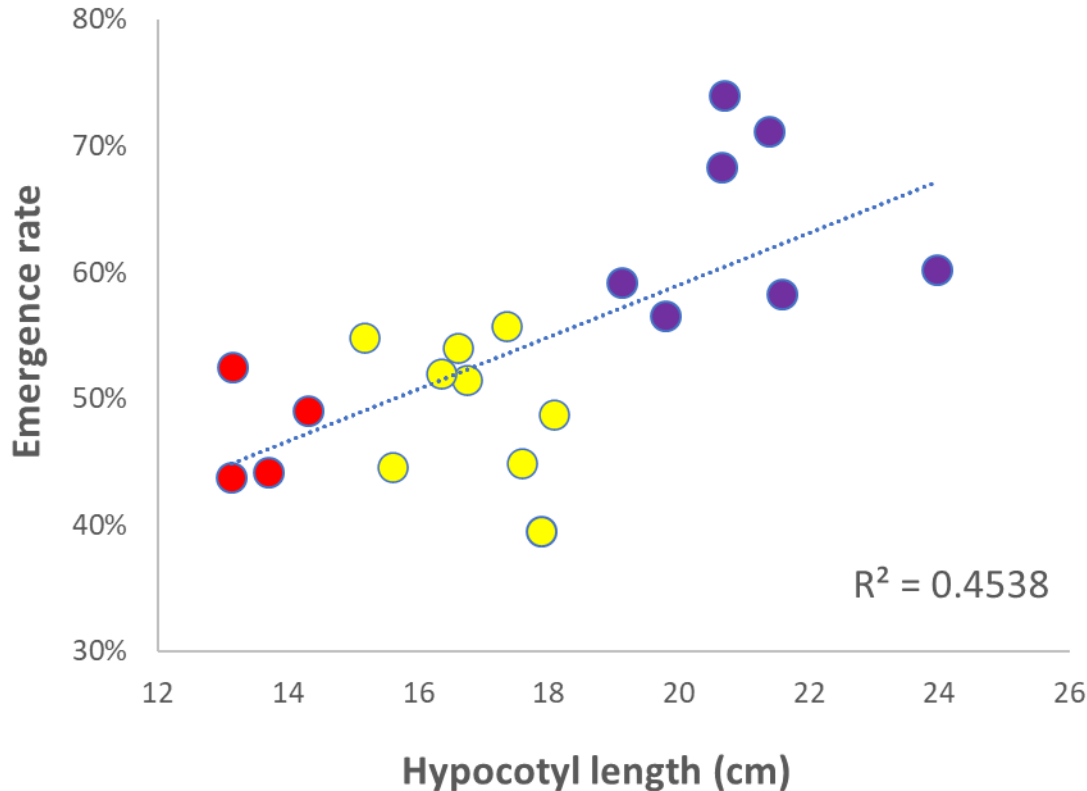


20 mm

50 mm

Boorowa 2021

# All the best emergers from 50mm had long hypocotyls

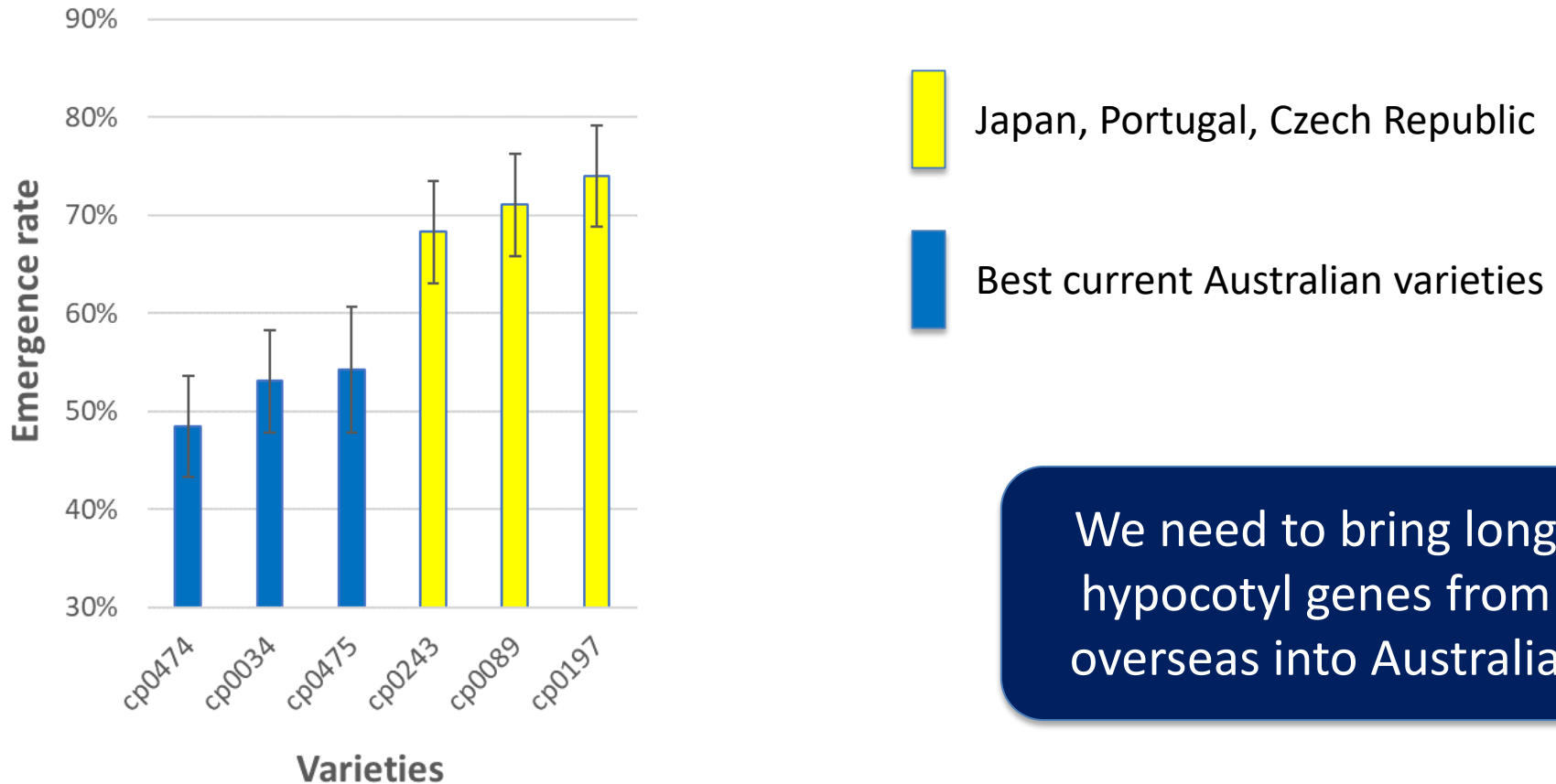


● Longest hypocotyl varieties were all from overseas

● Shortest hypocotyl varieties were all historic Australian

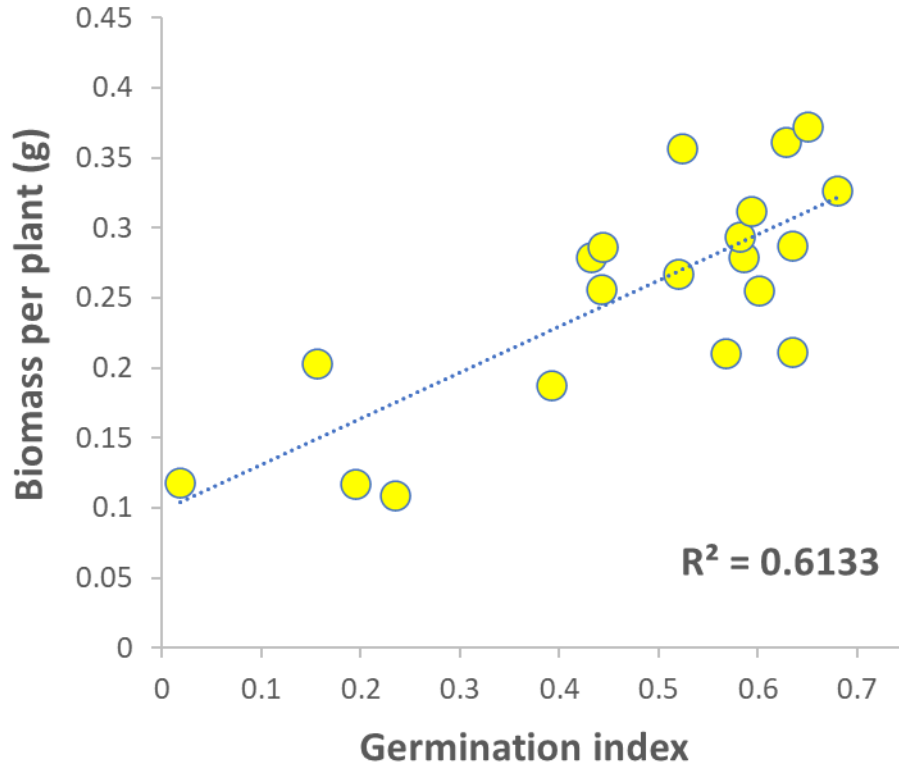
Hypocotyl length is an effective selection tool for picking the best emergers

# The best emergers were overseas varieties



We need to bring long hypocotyl genes from overseas into Australia

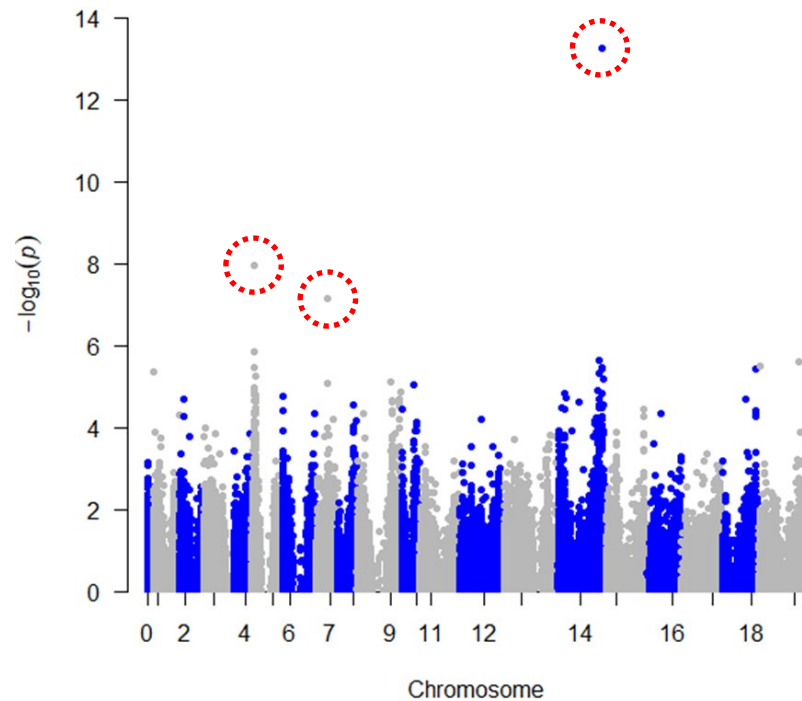
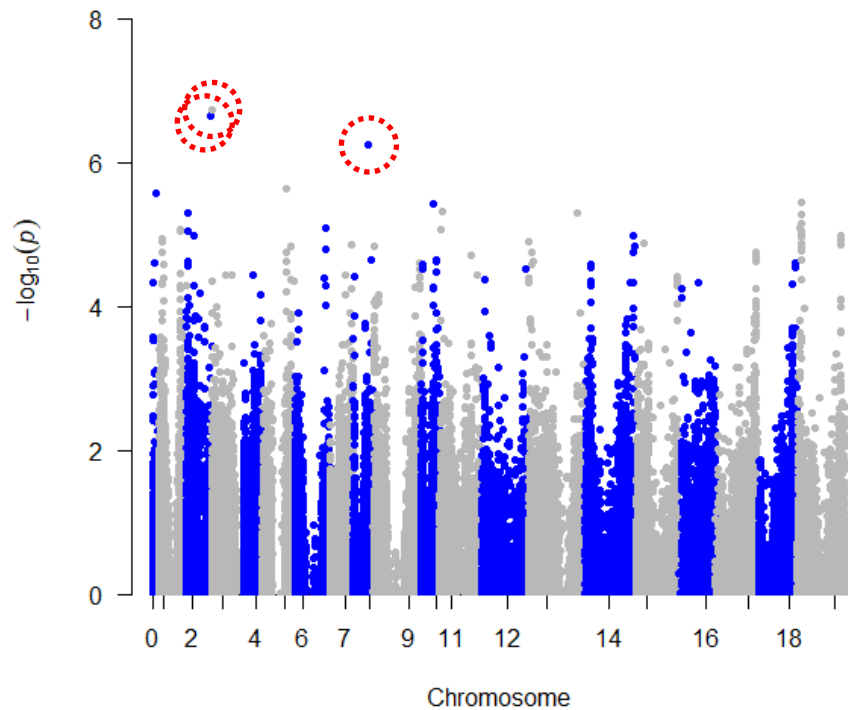
# Seed vigour (GI) is strongly predictive of field vigour



Seed vigour is a useful breeding tool and for testing seed lot vigour



# Hypocotyl length & seed vigour traits are polygenic



# Summing up

- Long hypocotyl varieties emerge better from deep sowing
- BUT... all the long hypocotyl varieties are from overseas
- We have developed efficient phenotypic selection tools
- Markers are under development
- Next step is to introgress long hypocotyl genes into vigorous Australian-adapted background(s)

# Acknowledgements



- Funding from GRDC and CSIRO
- CSIRO project team and Allison Pearson (GRDC)
- Breeding companies for providing seedlots of current Australian varieties and for productive conversations
- Kalyx, Living Farm and Boorowa Agricultural Research Station
- The growers and agronomists who responded to our survey



# Markers under development

- Seed vigour markers, still to test efficacy

