

# Residual benefits of dual phosphorus (P) placement to crops in south-eastern Australia

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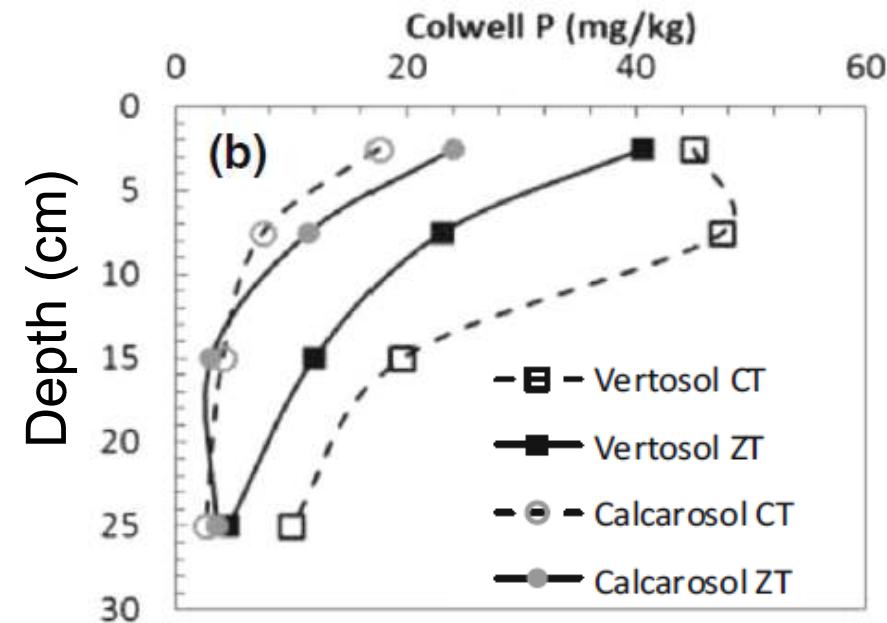
Roger Armstrong, Katherine Dunsford, Nigel Wilhelm, Therese McBeath,  
Kirsten Verburg, Rebecca Haling, Sean Mason and Graeme Sandral



Department of Primary Industries  
and Regional Development



# P stratification



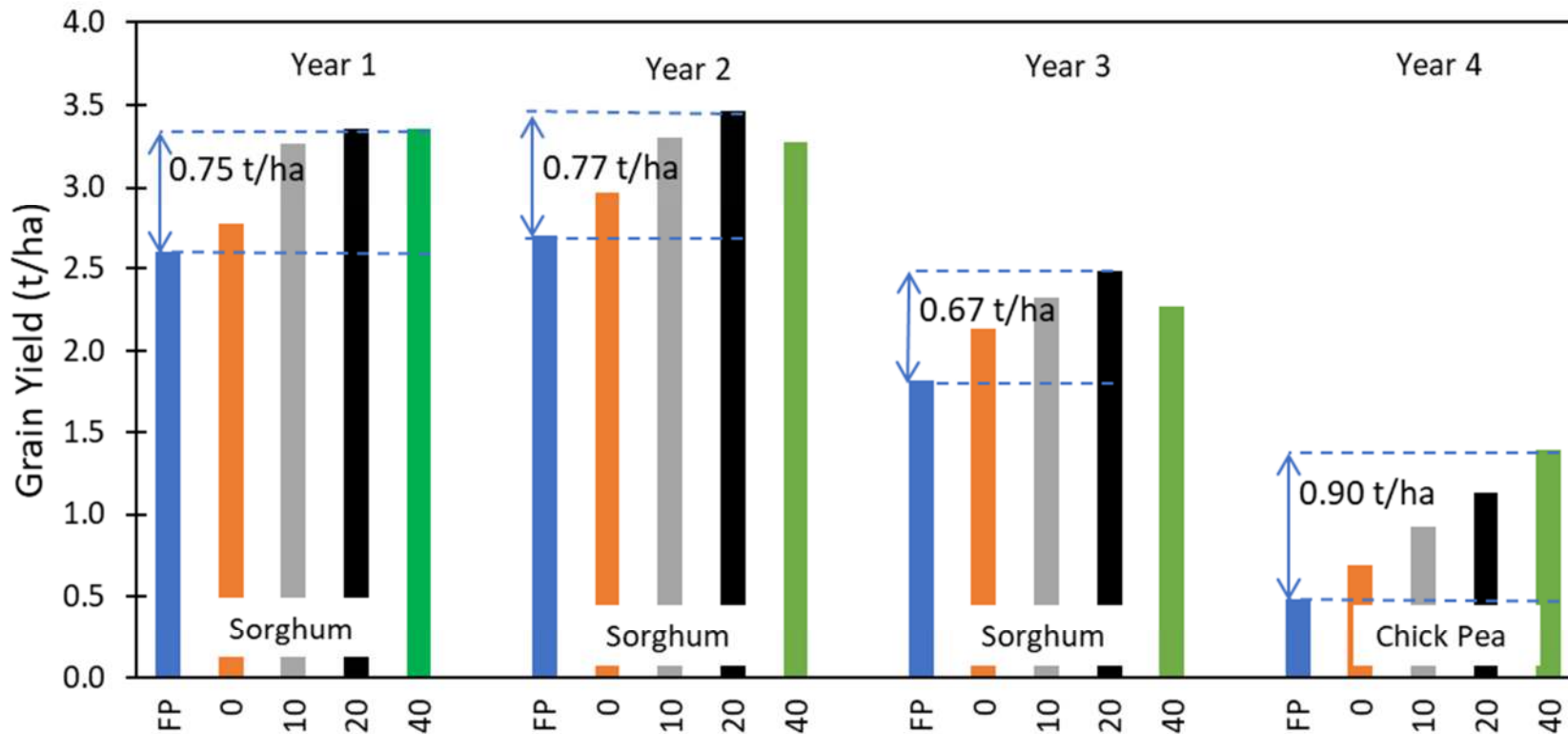
Armstrong et al. 2015, Plant Soil 396:297–309

- ❖ Repeated annual application at the surface soil
- ❖ P binding with Fe, Al and Mn at low pH and Ca at high pH as well as with clay particles
- ❖ No-till or minimum-till systems reduce soil mixing
- ❖ Stubble-retention systems recycle P to the surface

**Dry surface soil limits P uptake**

# Why examine dual P

In summer dominant rainfall environments deep P increases grain yield



FP = Farmer Practice with P applied at seeding, 0 to 40 = kg of deep P/ha

Site: Dysart QLD

Colwell P

0-10 cm = 5 (mg/kg)

10-30 cm = 1 (mg/kg)

FP = 6 kg P/ha applied at sowing each year

P rates 10, 20 and 40 applied in year 1 at 20cm depth and 50cm spacing

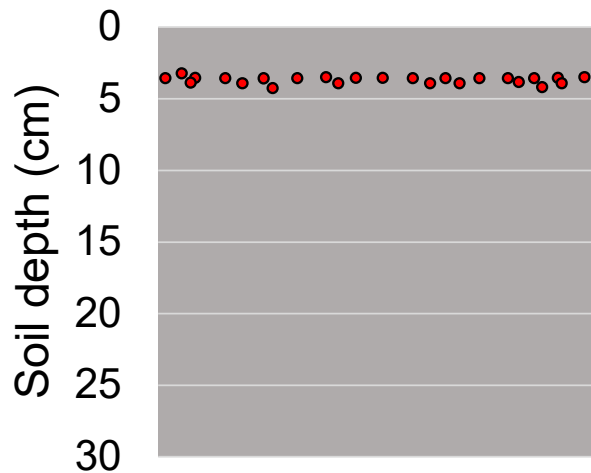
Bell et al (2016)

GRDC Update Goondiwindi

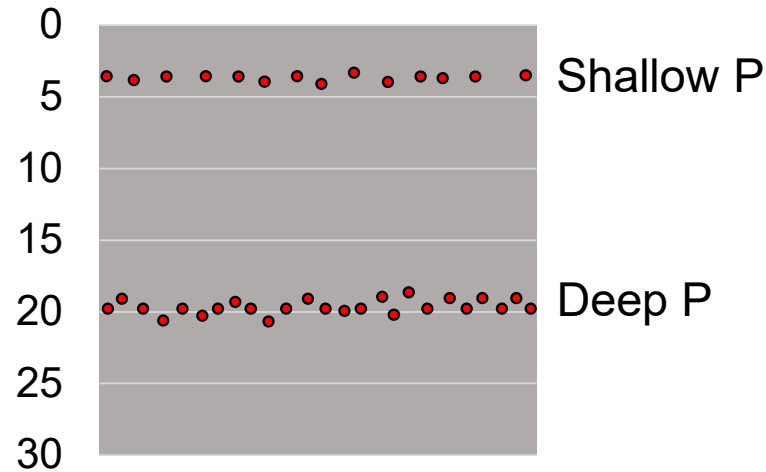
# Testing dual P in southern regions

## P placement strategies

### Shallow P



### Dual P



P source: MAP

Nitrogen was balanced at the respective depths

All treatments were ripped to ~20cm depth

### Shallow bands

- ❖ At ~3 – 5 cm depth
- ❖ Every seeding row
- ❖ 25cm band spacing

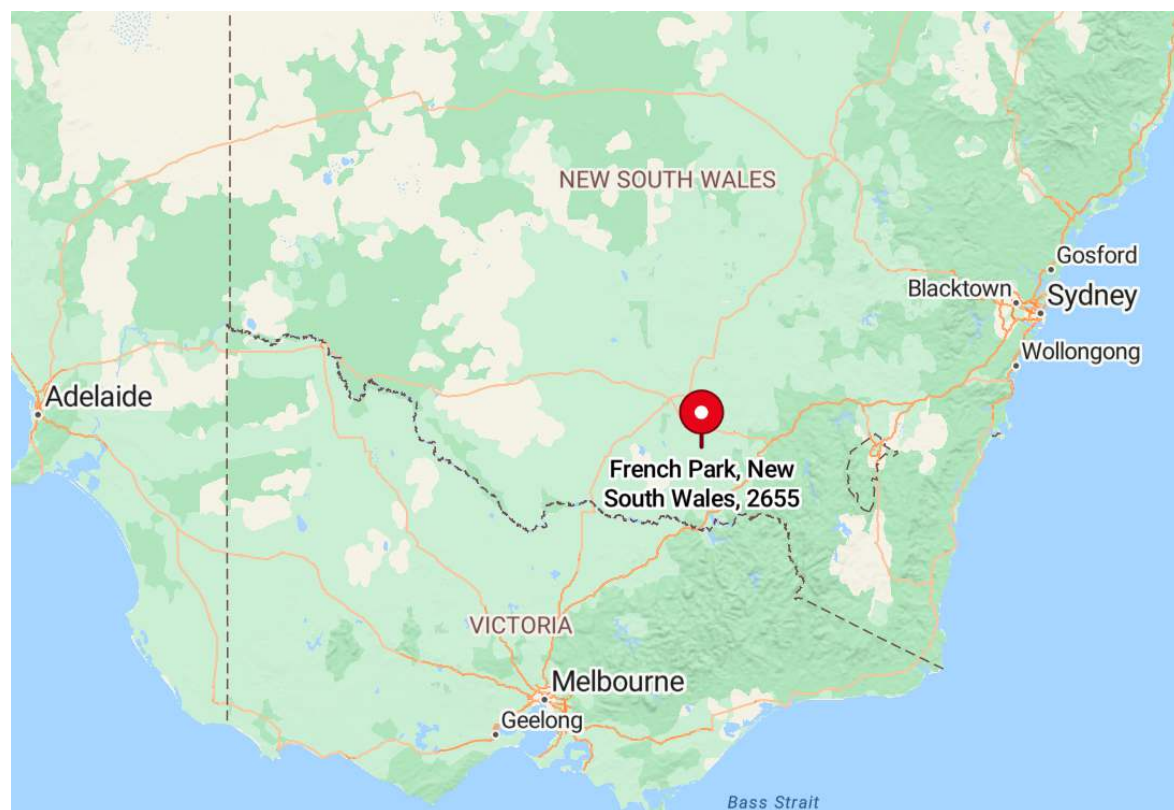
### Deep bands

- ❖ At ~20cm depth
- ❖ Between seeding row
- ❖ 50cm band spacing

# French Park: southern NSW

Site	Depth (cm)	pH (1:5 water)	Organic C (%)	Colwell P (mg/kg)	PBI
French Park	0 - 10	6.7	1.6	34.7	81
	10 - 30	7.9	0.6	3.8	83

Year	Annual rainfall (mm)	GSR (mm)
2020	560	365
2021	855	344
2022	1060	553
2023	532	200
2024	261	209
Long-term	520	325

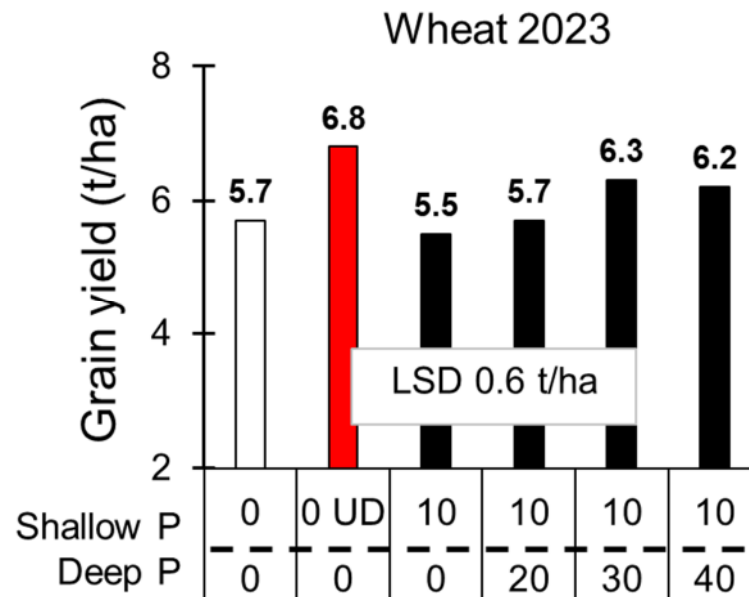
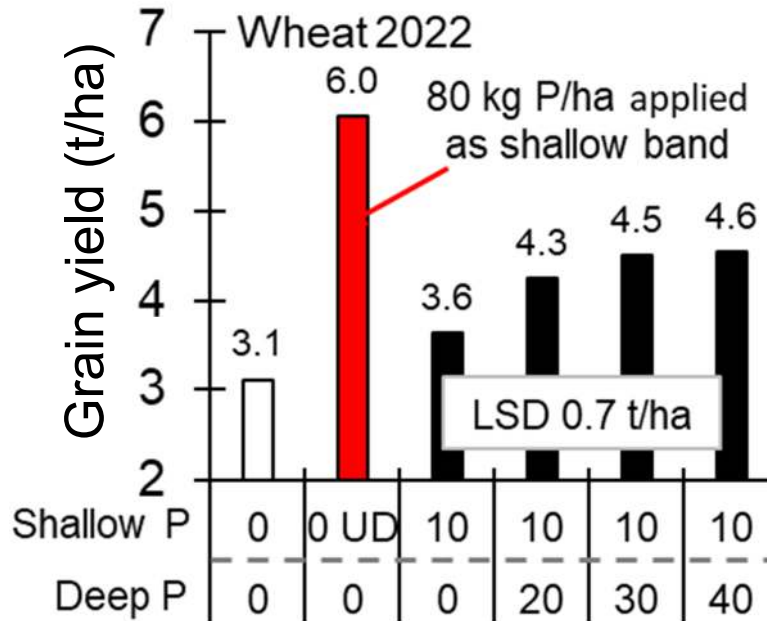
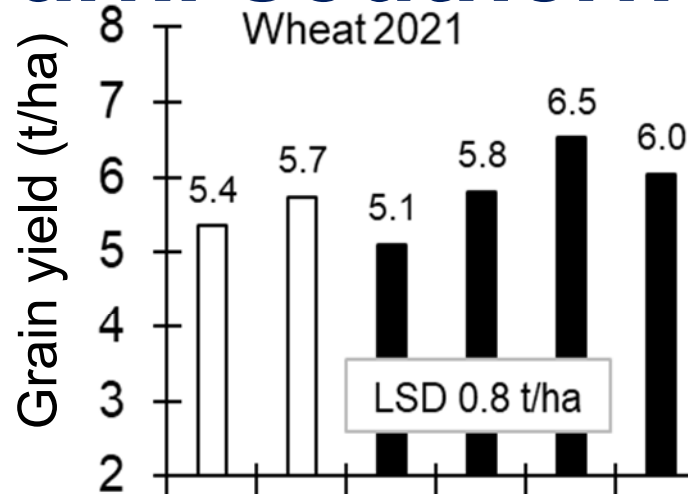
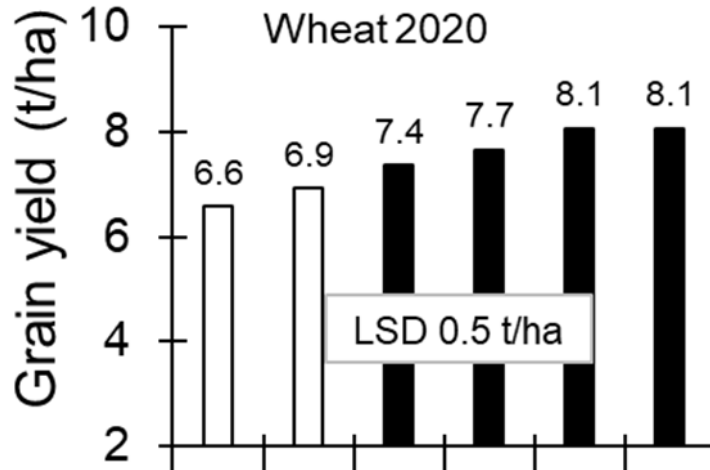


# French Park: southern NSW



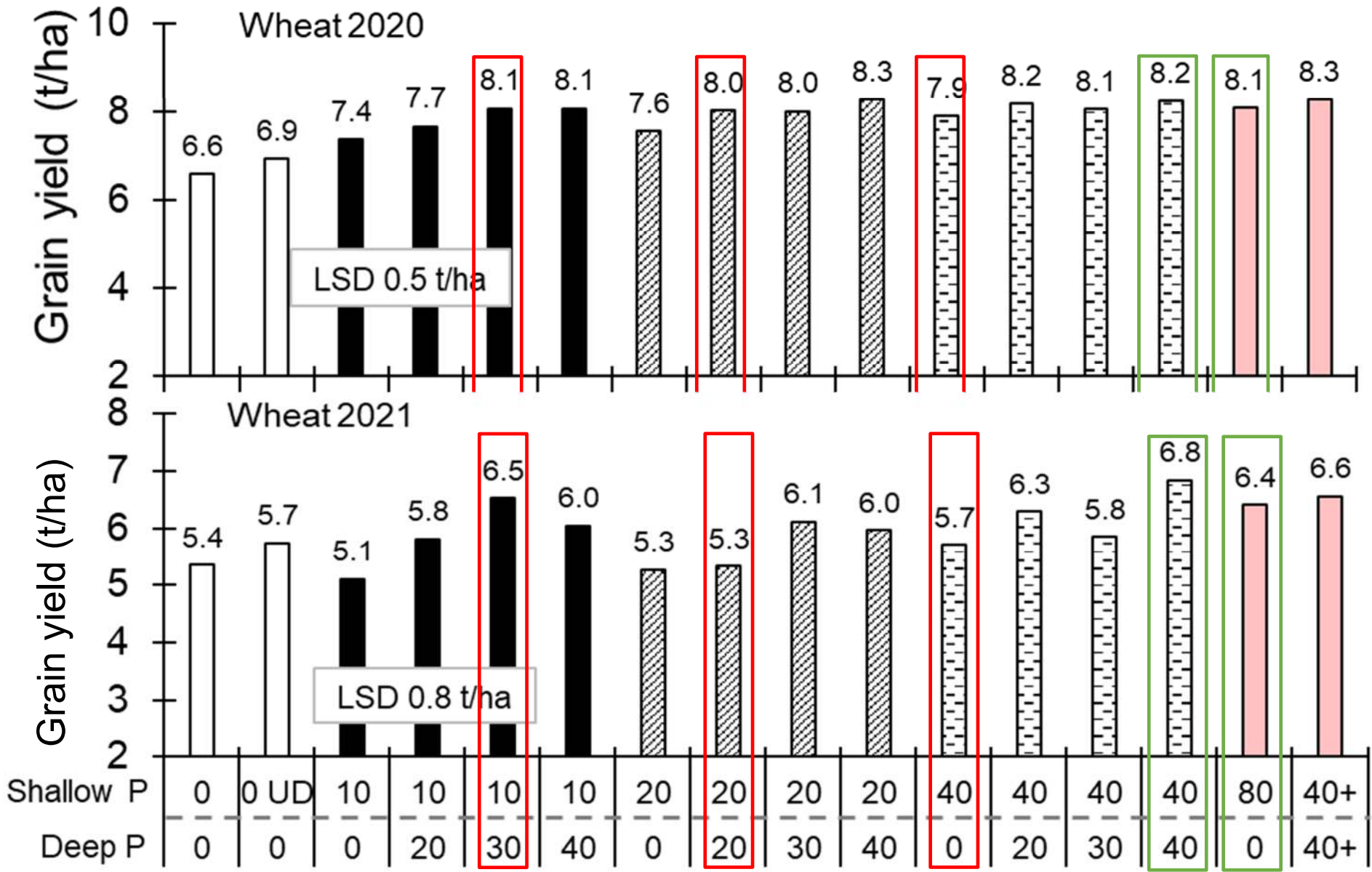
Photo credit: Matt Dunn

# French Park: southern NSW

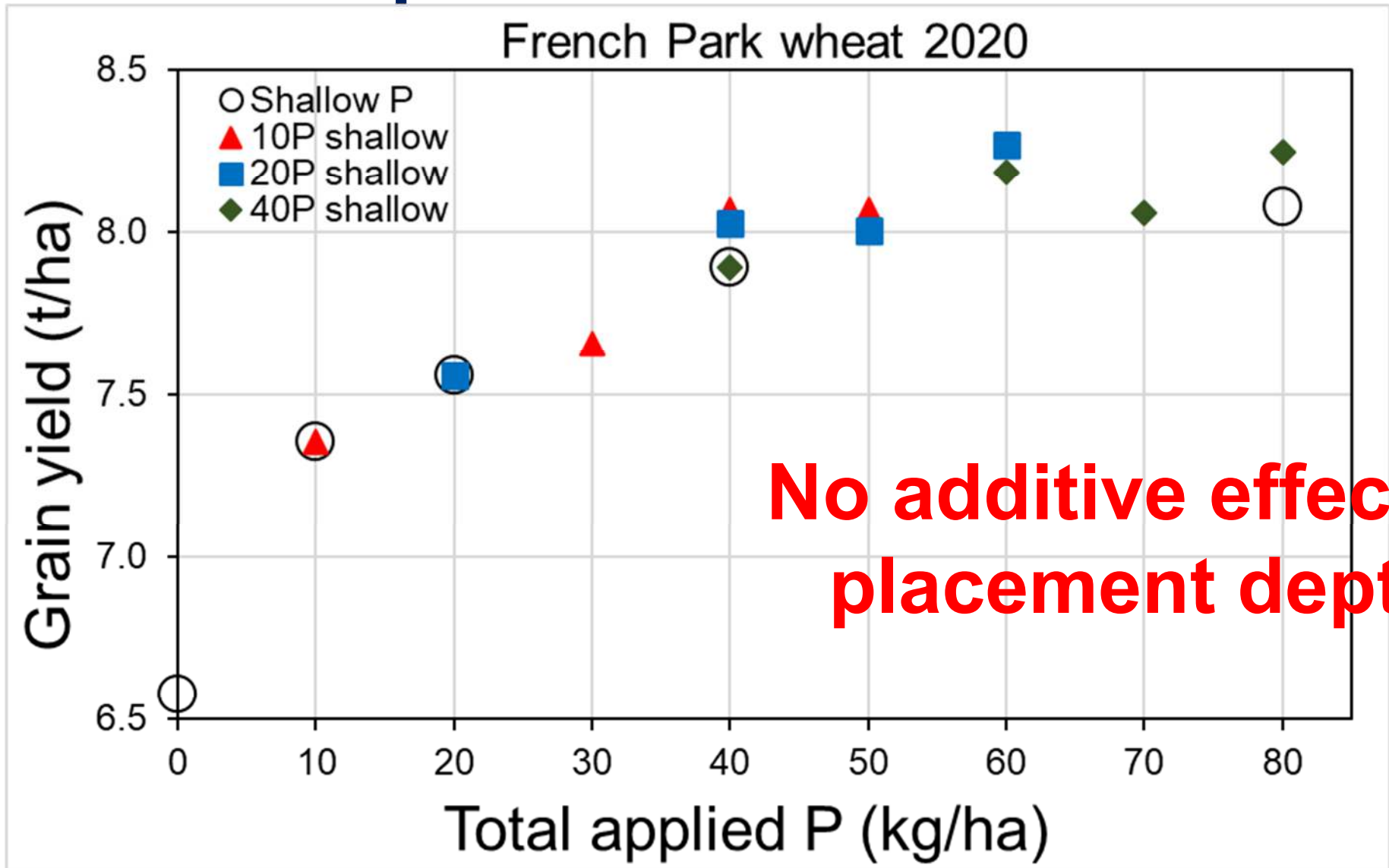


**Consistent responses with the northern growing regions!!!**

**Is it driven by rates or depth?**

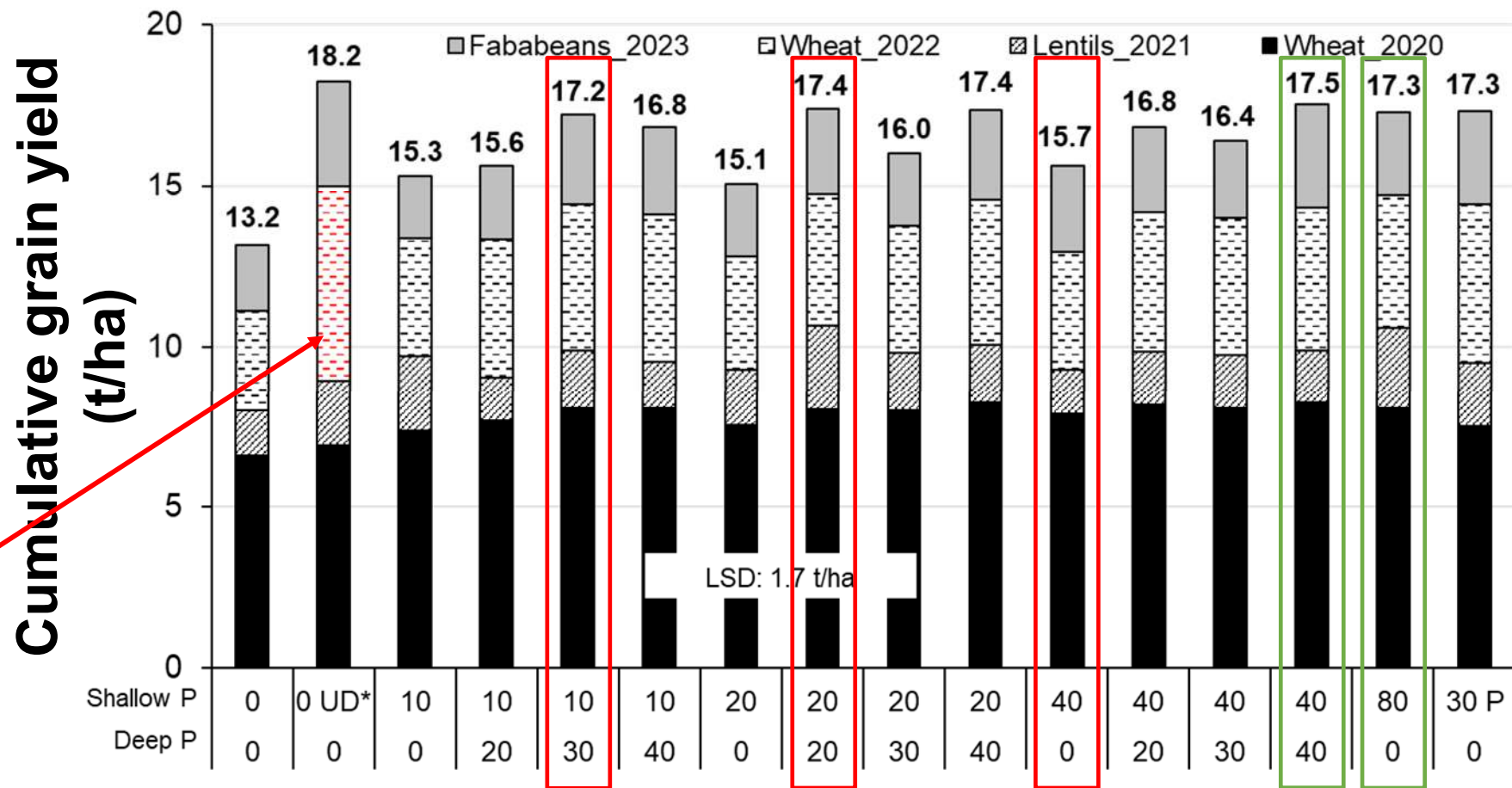


# Yield responses were due to P rates



# Cumulative yield over four seasons

Year	Trial 1
2020	Wheat
2021	Lentils
2022	Wheat
2023	Fababean



80 kg P/ha as shallow band in 2022

# Residual P response during the third season

## Crops in 2024 season



80 kg P/ha as shallow band in 2022

Nil P



2022 wheat 3.1 6.1 t/ha  
2023 faba 2.2 3.2 t/ha

Nil P

80 kg P/ha as shallow band in 2022

# Pinnaroo: SA

Rainfall: 350 – 450 mm

Sandy soil

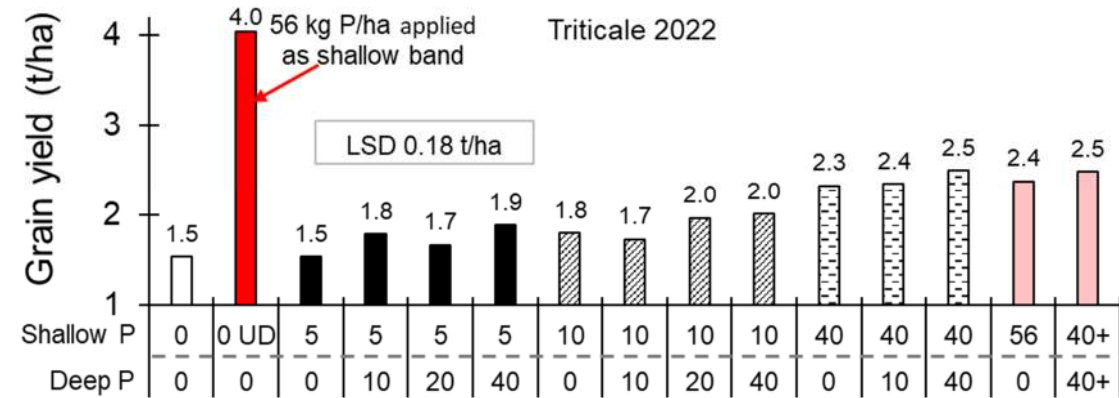
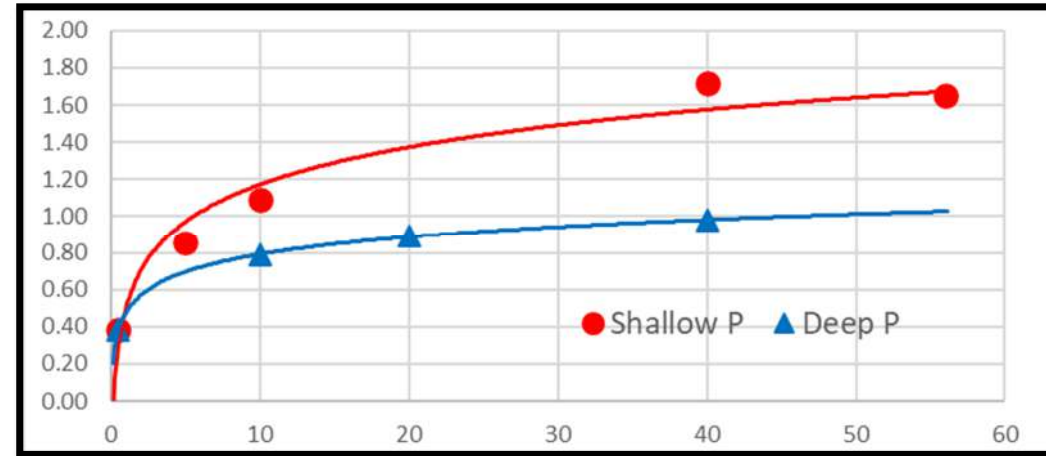
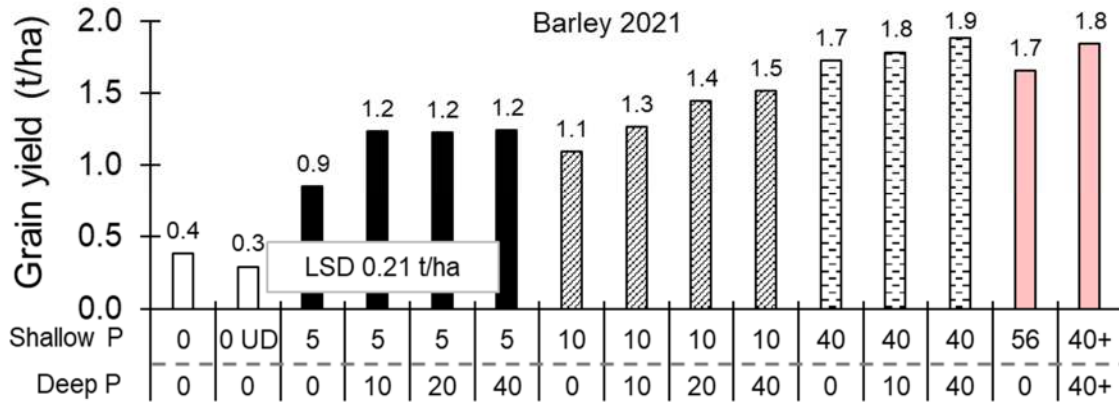
Colwell P: <5 mg/kg (0–10cm)



Source: Nigel Wilhelm, SARDI



# Pinnaroo: SA



# Summary

- ❖ Grain yield increases with increasing P: **no effect of placement depth**
- ❖ Dual P provided little evidence of yield advantage (**only in two cases out of 49 trial years data**)
- ❖ Shallow P application provided the likely best economic return compared with the dual P
- ❖ Residual P effects were evident during the fourth year in 2023 from their initial applications in 2020
- ❖ Fresh P outperformed residual P

# ACKNOWLEDGEMENTS



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and Regional Development



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## Thank you all

### DPI2001-033

“Maximising uptake of phosphorus by crops to optimise profit in central and southern NSW, Victoria and South Australia”



**Roger Armstrong**  
**Katherine Dunsford**



**Therese McBeath**  
**Kirsten Verburg**  
**Rebecca Haling**



**Nigel Wilhelm**



**Prof. Mike McLaughlin**  
**Will Tucker**



**Olivia Brunton**



**Sean Mason**