Department of Primary Industries and Regional Development

GOVERNMENT OF WESTERN AUSTRALIA

Protect
Grow
Innovate

Assessing soil amelioration on gravel soils in the Great Southern of Western Australia for the management of water repellence

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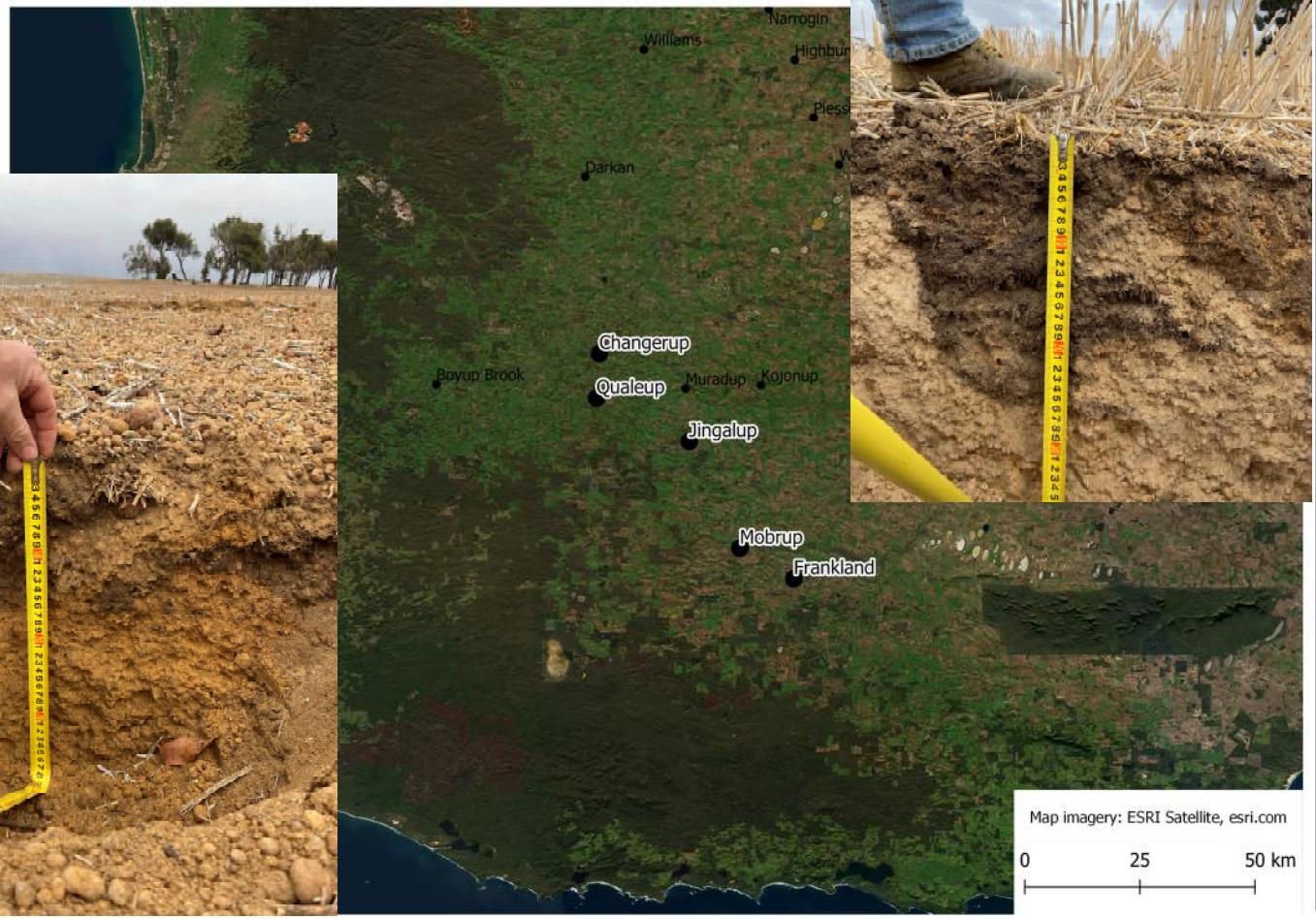
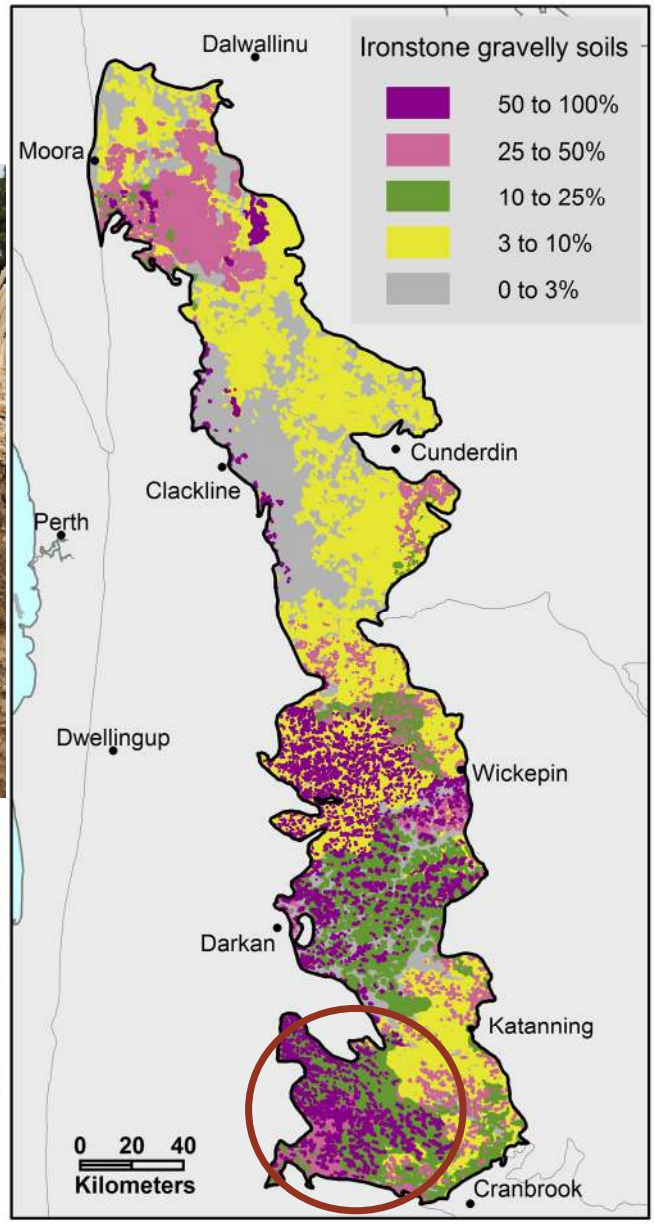
Key messages

- There were large variations in % yield gains within soil types over different seasons.
- Densely packed soil restricted depth of machine working.
- This is a highly water repellent environment and it is likely water repellence will still impact on crop establishment post amelioration.

Environment

Distribution of ironstone gravel soil in the Moora to Kojonup region of WA. (DPIRD)





Soil mixing

‘Grizzly Tiny’ two-way offset disc plough

Two disc sizes:
42inch / 107cm
36inch / 91cm

Soil inversion

‘Plozza’ modified one-way disc plough

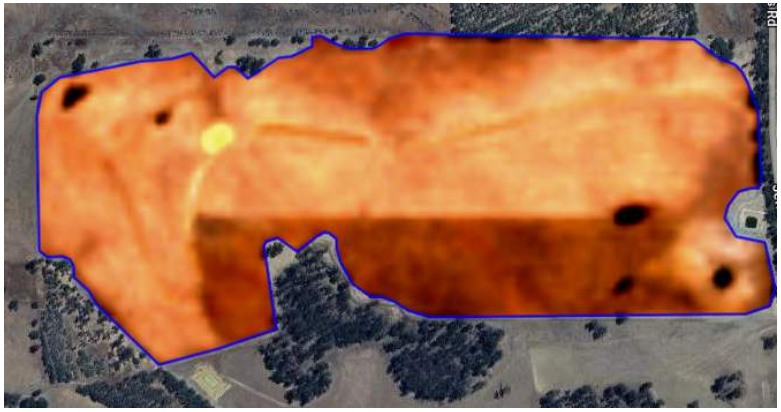
Grizzly tiny diluted the repellent layer through soil mixing

https://grizzlyag.com.au/equipment/tiny-230-the-best-farmers-plough/

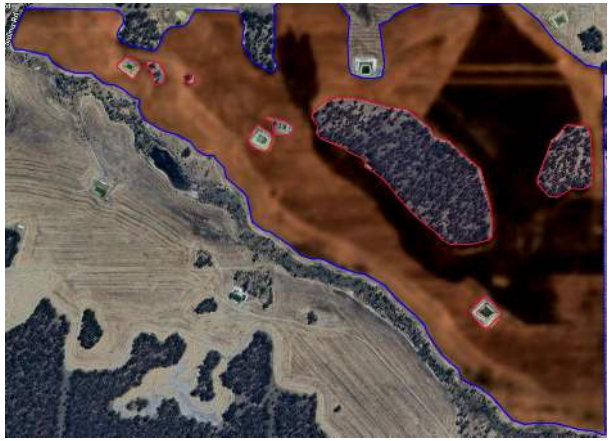
https://www.mcintoshandson.com.au/stock/details/OAG-AD-22960016/2022-grizzly-tiny-390xl-new

Site Implementation

Jingalup – March 2022

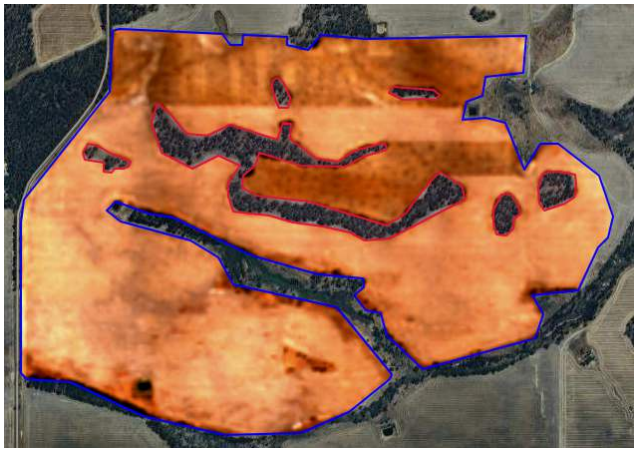


Changerup – April 2021



Qualeup
March 2020

Frankland - February 2023

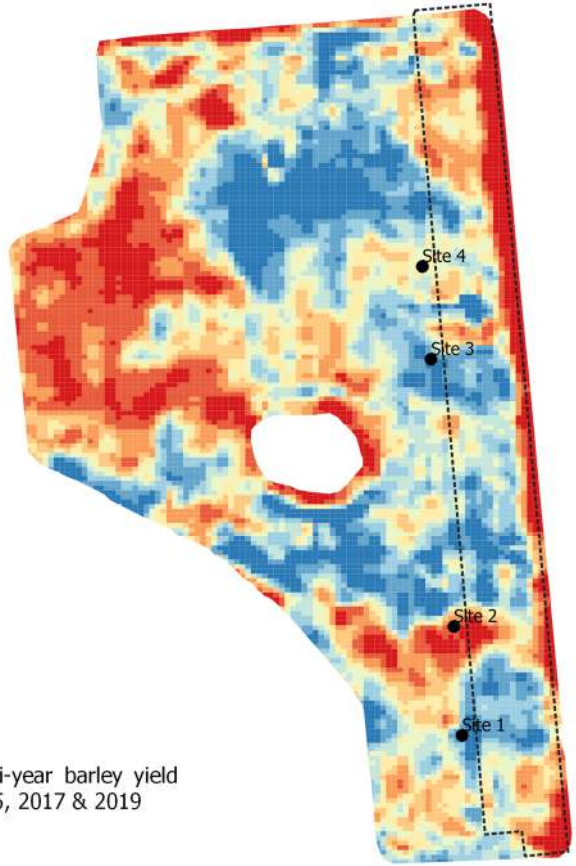


Mobrup - March 2022

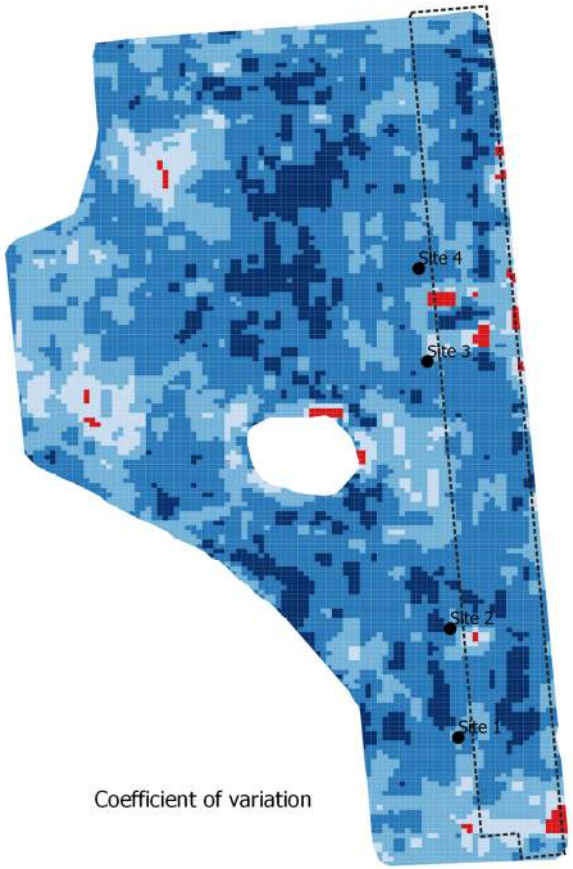
Selecting observation sites

Highly variable environment

Highly variable due to topography and multiple soil types



Multi-year barley yield
2015, 2017 & 2019



Coefficient of variation

Legend

Sites

- Site 1
- Site 2
- Site 3
- Site 4

Multi-year barley yield (normalised)

- 5.2 - 37.6
- 37.6 - 42
- 42 - 45.4
- 45.4 - 47.8
- 47.8 - 49.9
- 49.9 - 52.1
- 52.1 - 54.3
- 54.3 - 56.7
- 56.7 - 59.9
- 59.9 - 78.8

Multi-year barly yield (t/ha) 2015, 2017 & 2019

- 1.13 - 3.33
- 3.33 - 3.62
- 3.62 - 3.85
- 3.85 - 4.02
- 4.02 - 4.17
- 4.17 - 4.3
- 4.3 - 4.45
- 4.45 - 4.63
- 4.63 - 4.84
- 4.84 - 6.5

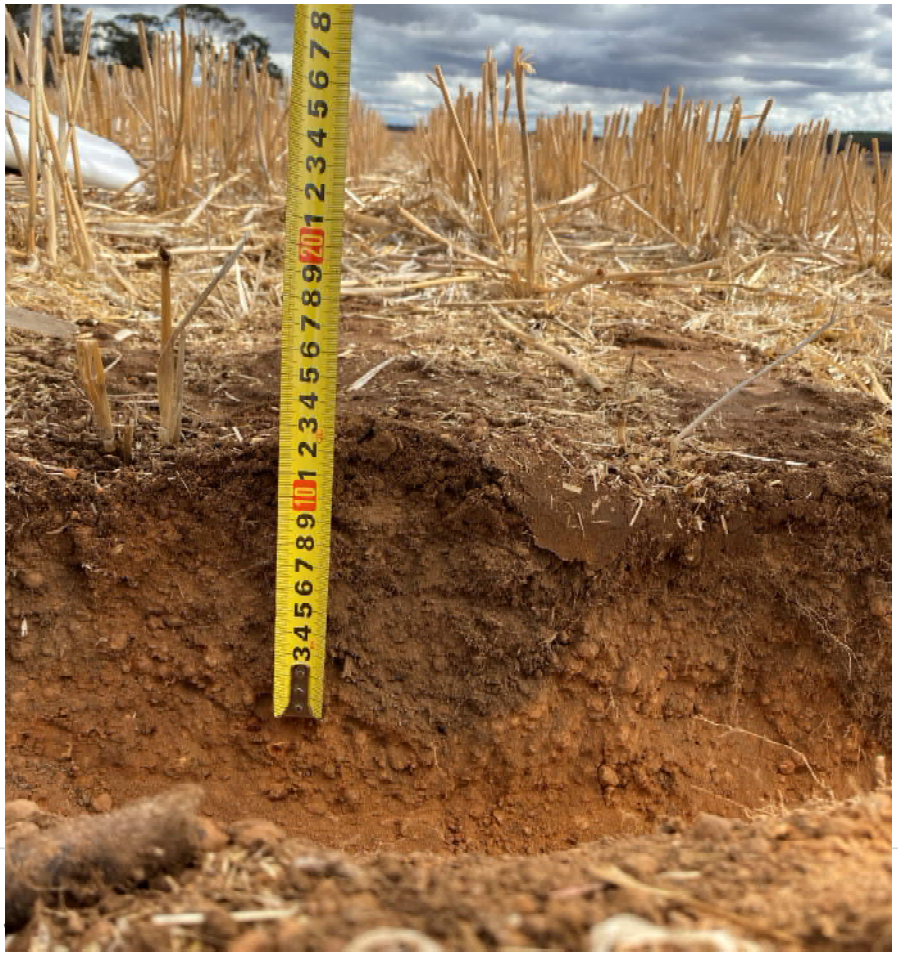
Coefficient of variation

- 0 - 0.125
- 0.125 - 0.25
- 0.25 - 0.375
- 0.375 - 0.5
- 0.5 - 1

0 100 200 m

Depth of Amelioration

Grizzly Tiny

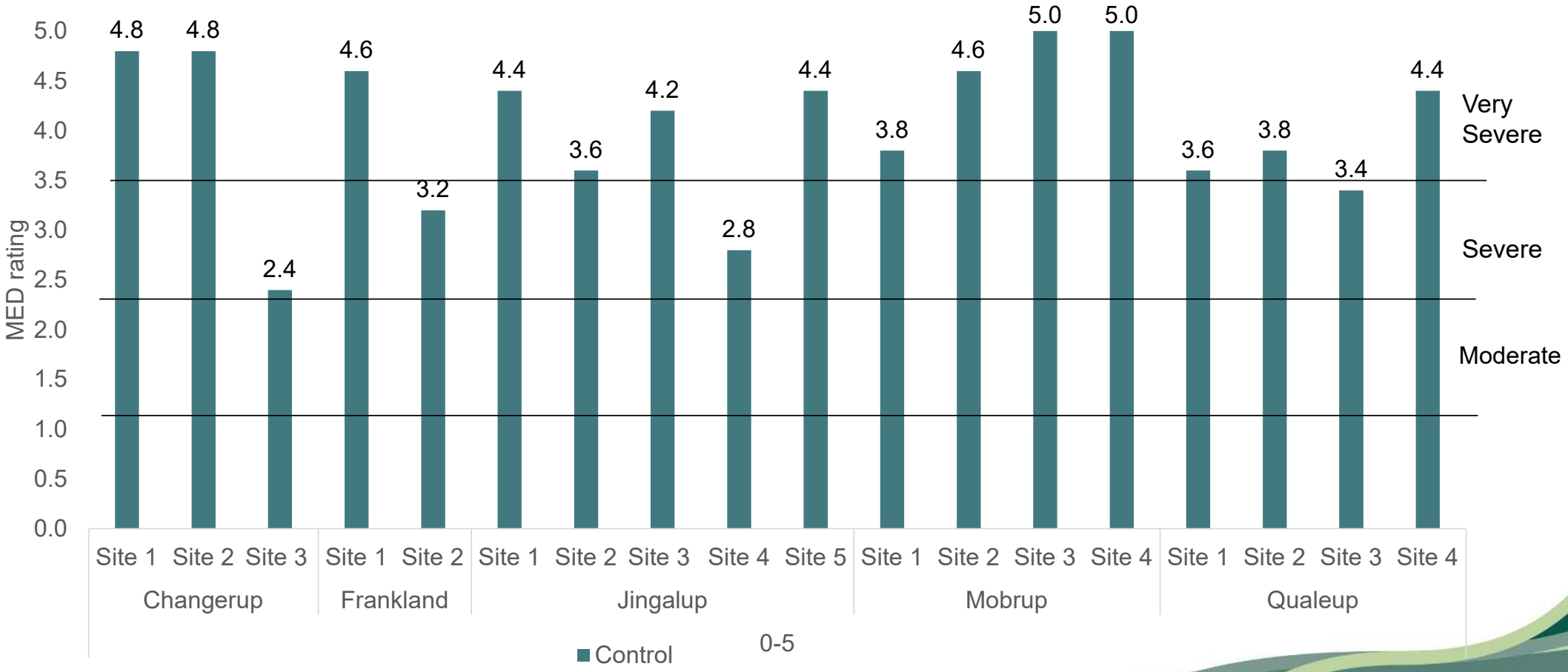


Molarity of Ethanol Droplet (MED) Rating

Level	Rating
Very Severe	3.5 – 5
Severe	2.3 – 3.5
Moderate	1.1 – 2.3
Low	0.1 – 1.1

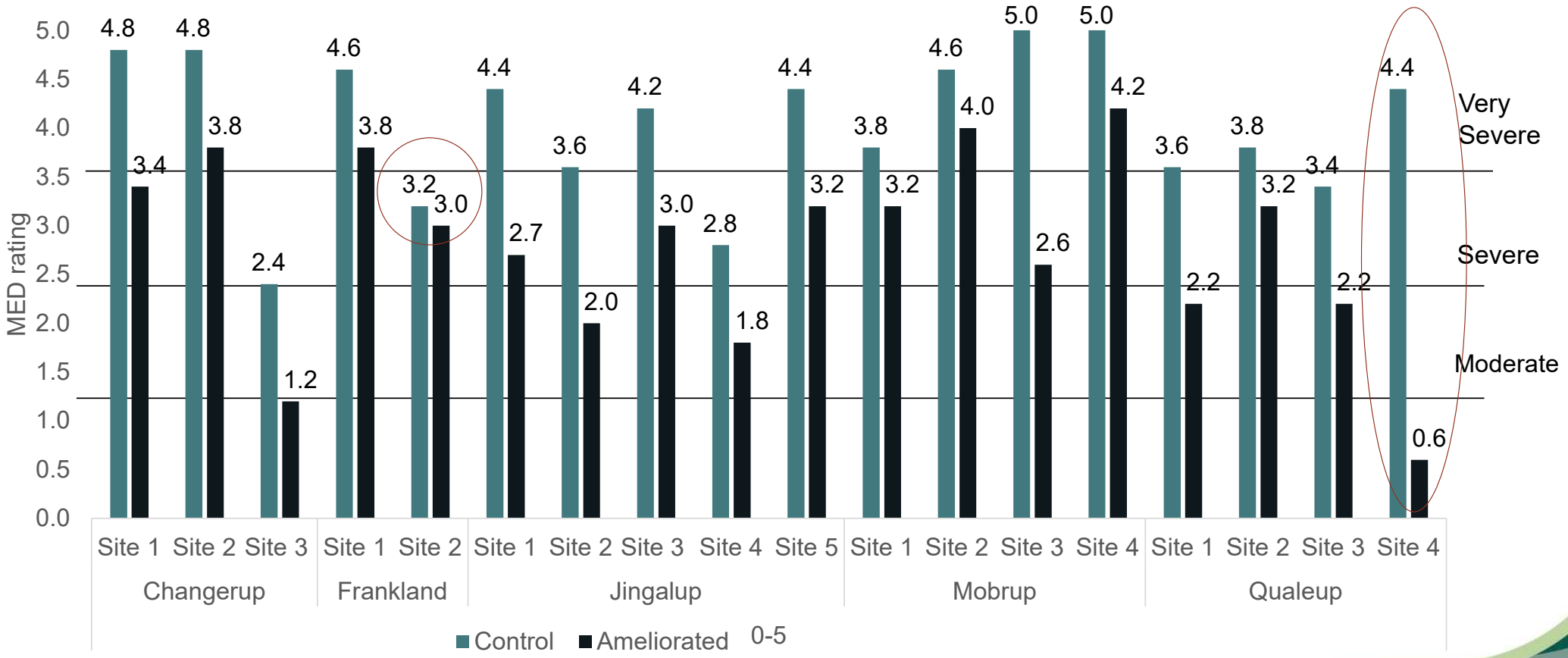
Molarity of Ethanol Droplet (MED) Rating

Topsoil 0-5 cm layer



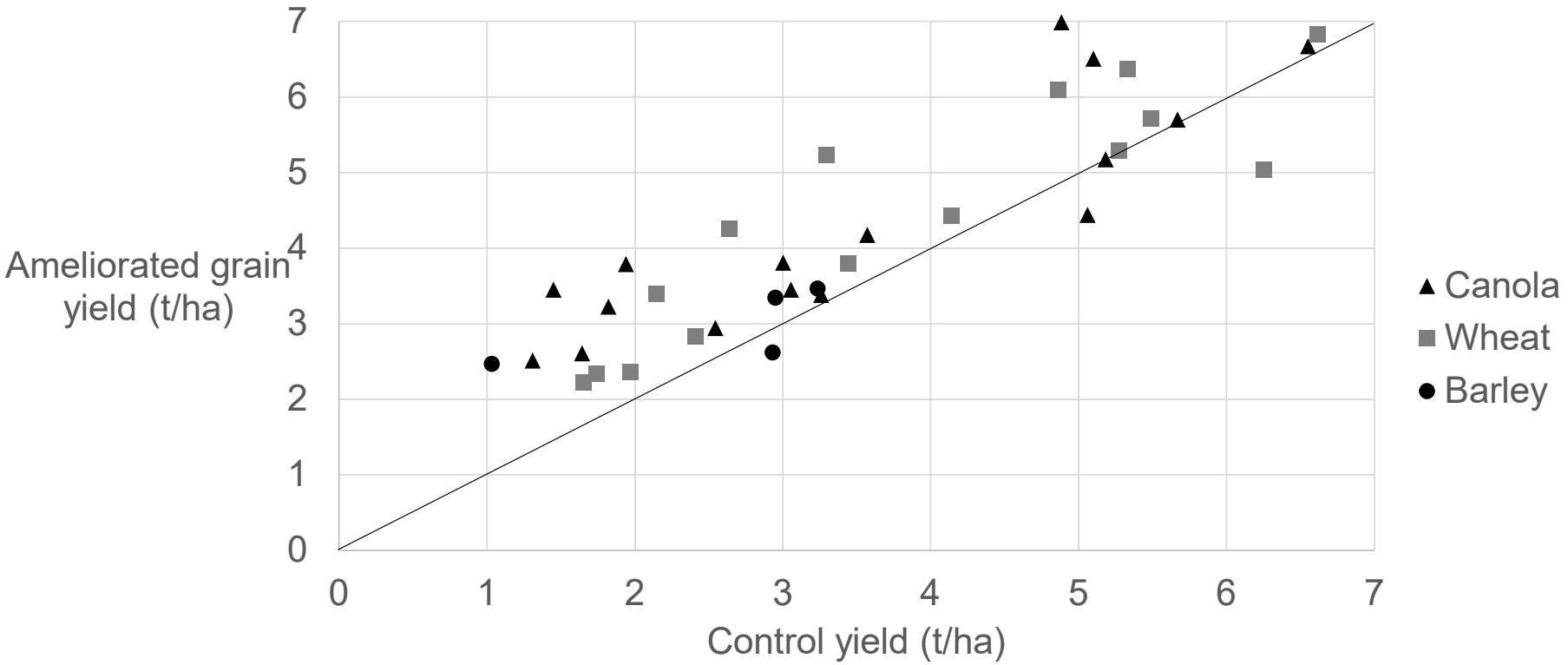
Molarity of Ethanol Droplet (MED) Rating

Topsoil 0-5 cm layer



Grain yield improvements

*Negative yield responses were all from the 2023 where **6-15 mm of rainfall was received during key grain fill period.***

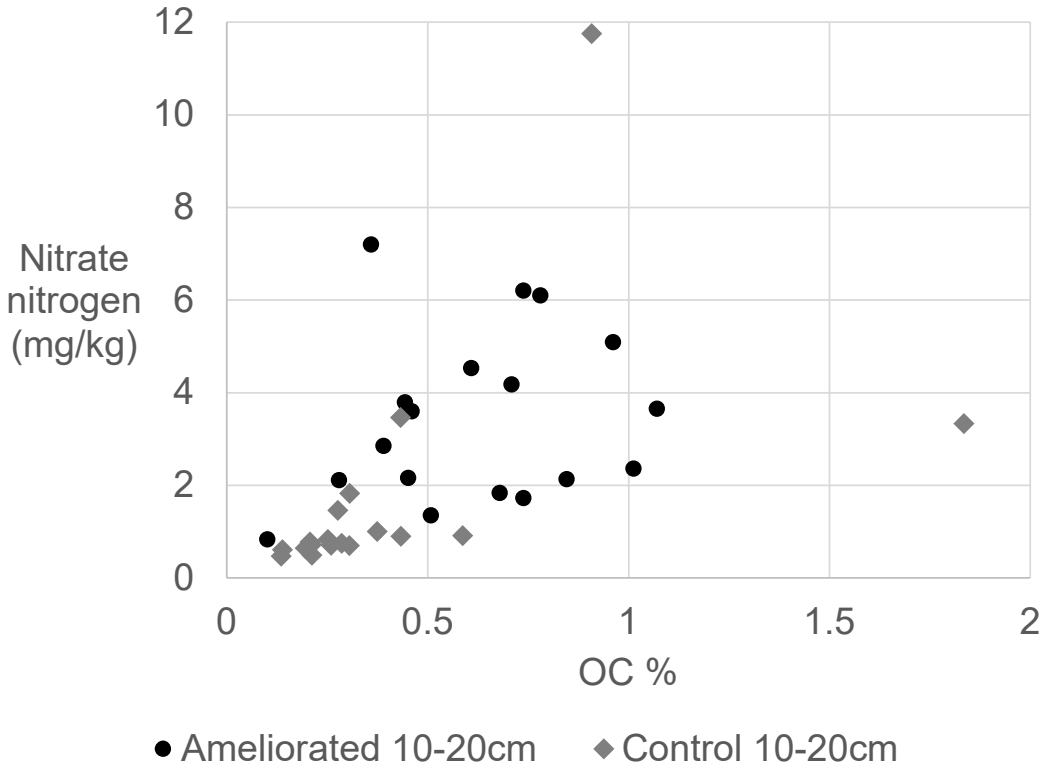


Yield Response – Soil Types

Soil type	Number of sites	Number of yield observations (sites by seasons)	Average topsoil MED rating - control	Average topsoil MED rating - ameliorated	Average topsoil MED rating - % reduction	Min % yield gain	Max % yield gain	Average % yield gain
Loamy gravel	1	2	2.8	1.8	36%	**3%**	**13%**	**8%**
Shallow gravel	11	19	4.5	3.3	27%	**-11%**	**139%**	**26%**
Duplex sandy gravel	4	10	3.7	2.0	42%	**-20%**	**95%**	**27%**
Brown deep sand	1	1	2.4	1.2	50%	**58%**	**58%**	**58%**
Deep sandy gravel	1	3	3.8	3.2	16%	**7%**	**138%**	**79%**

Other benefits

Subsoil OC% & Nitrate



15 of the 18 paired sample sites had higher levels of nitrate nitrogen in the ameliorated treatment at 10-20cm

Other benefits – **Soil loosening**

Soil loosening

72-82 % gravel
<2% clay

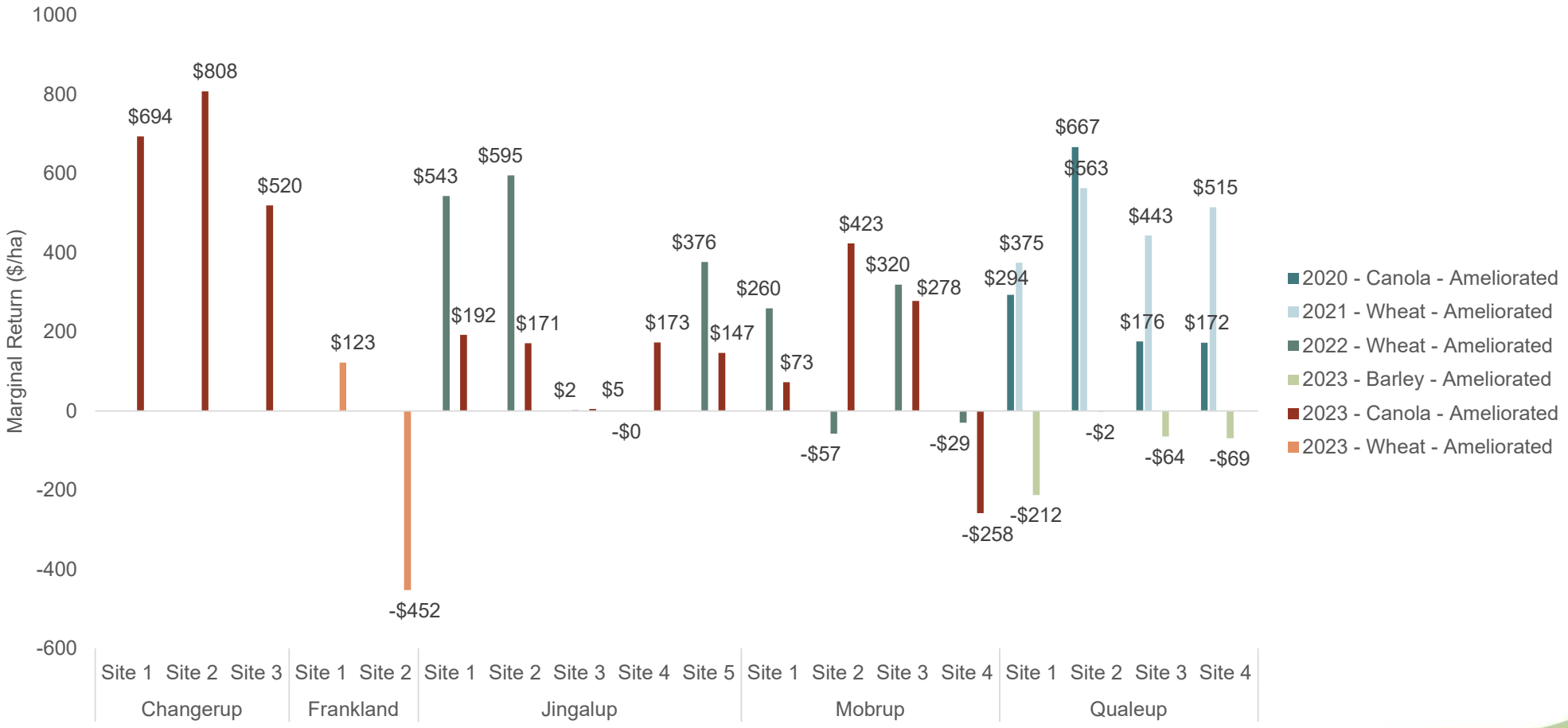
Low water holding capacity

Greater root growth to the depth of machine working

Marginal Return ($/ha)

Amelioration cost
$200/ha spread over
3 years = $67/ha/year

Kwinana Port FIS grain price
$610/t for canola
$315/t for wheat
$233/t for barley



Key Messages

- There were large variations in % yield gain - be mindful of seasonal interactions.
- Densely packed soil restricted depth of machine working.
- Highly water repellent environment and it is likely water repellence will still impact on crop establishment post amelioration.
- Other flow-on effects due to soil mixing which will improve in-season crop growth:
    - Soil loosening
    - Higher organic carbon and nitrate nitrogen levels within the subsoil

Thank you

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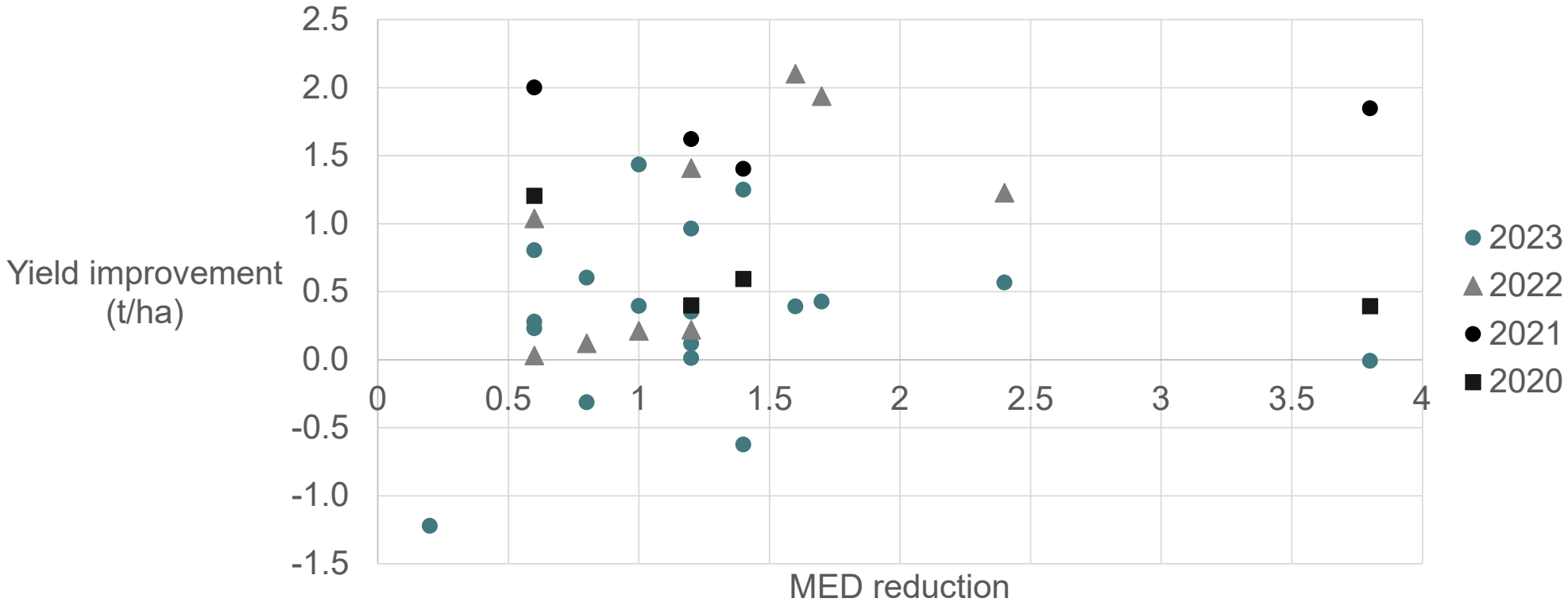
Yield improvements against MED reduction



Topsoil clay % and MED