MFS Soils Club Dec 2019: *Rebecca Haling/ Richard Simpson (CSIRO)*

Sulfur management on the Monaro: objectives

1. **Deep soil nutrient profiles measured during autumn at 15 sites**
   (5 sites on each of basalt, granite and shale-based soils)

   → *Aim: to determine where S is ending up in soil profiles*.

2. **Pasture response to S-fertiliser at all 15 nutrient profile sites**

   → *Does the 0-10 cm S soil test adequately indicate S responsiveness?*

   → *What value should we place in deep S?*

3. **Soil test response to <u>gypsum</u> at 6 nutrient profile sites**

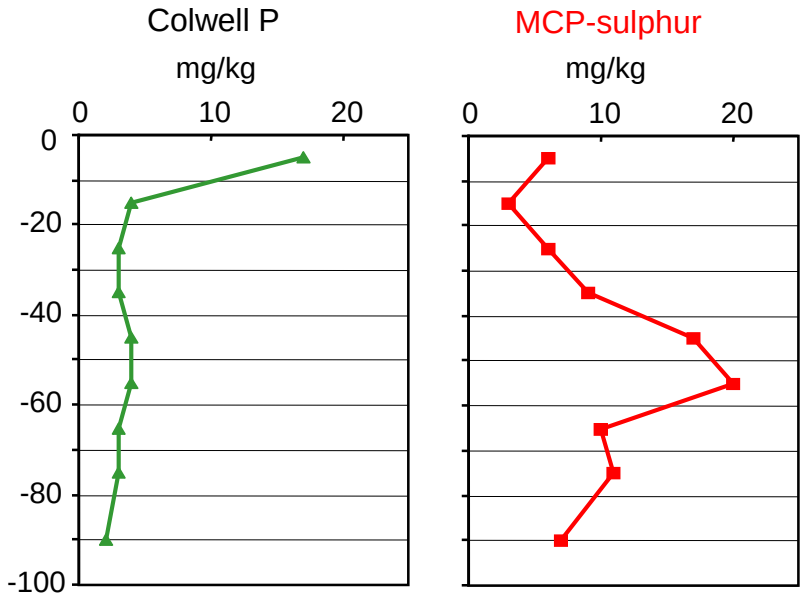
   → *How many **kg S/ha** to raise KCl_{40}-S test by 1 unit?*

   … to assist fertiliser rate planning and calculations

Why measure deep soil nutrient profiles?

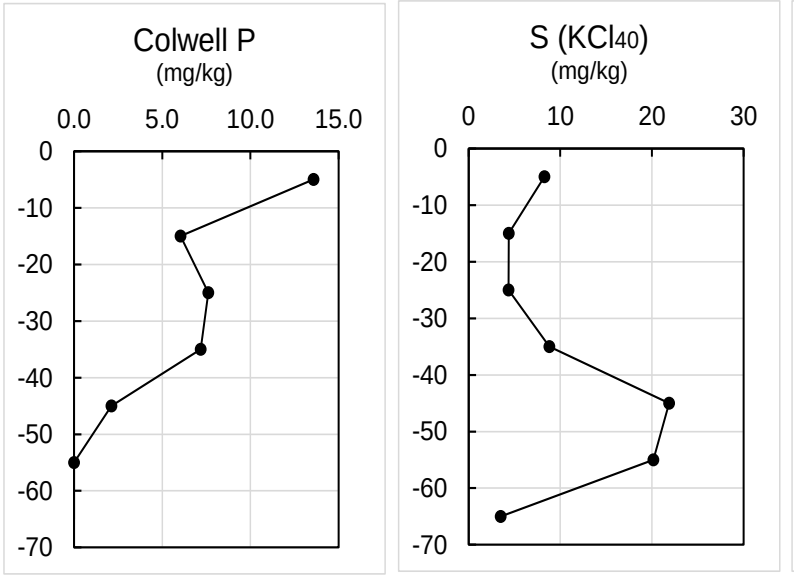
Granite-based soil

Erosion paddock (1999)
(Connemara, via Tarcutta)



Granite/basalt-trans soil

Loam grading to clay
(Merrill, via Gunning)



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What we achieved…

1. **Deep soil nutrient profiles measured at 9 of 15 sites in 2018**

   → *remaining 6 sites too dry to core; revisited in Nov 2019 and currently analysing 3 more sites*

2. **Pasture response to S-fertiliser set up at 15 sites in 2018**

   → *2 sites harvestable in 2018*
   → *revisited sites in spring 2019 but none harvestable; soils sampled*

3. **Soil test response to gypsum at 6 sites set up in 2018**

   → *soils sampled in spring 2018; soil analyses completed in 2019*
   → *revisited sites in spring 2019; soils sampled*

What did we find?

Deep nutrient profiles 2018 results

"Shale" soils

If the surface soil result is below critical, you need to be applying S.

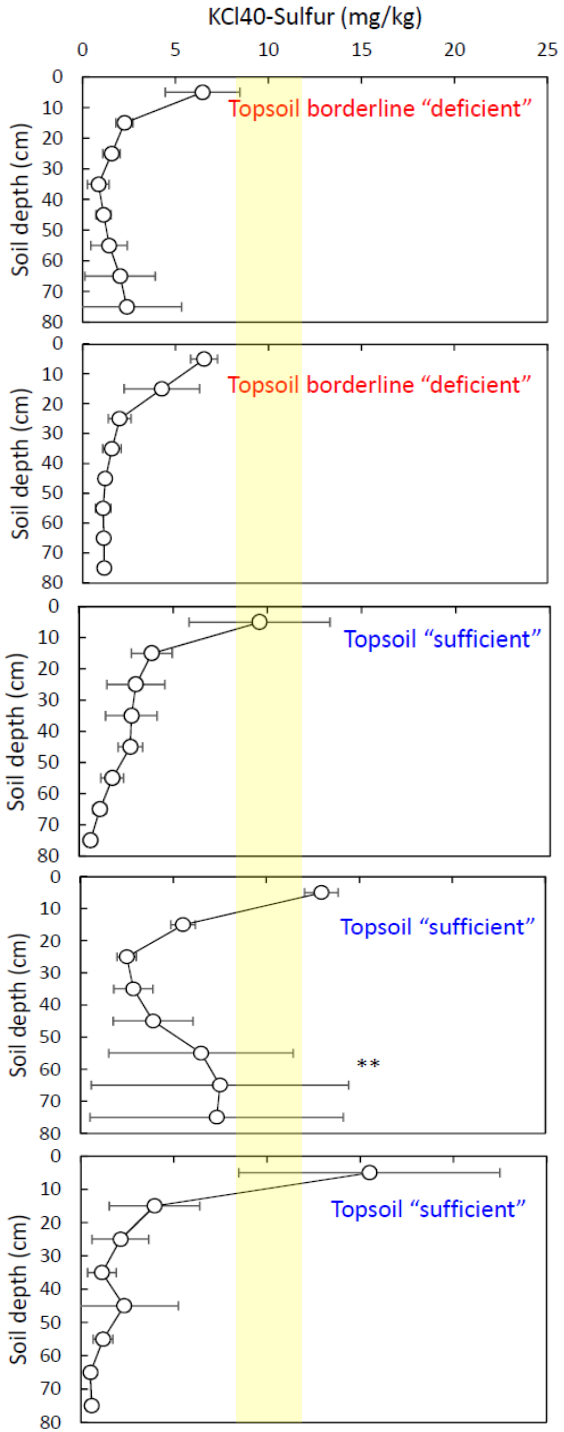
Oli Cay 2

Dean Campbell

Oli Cay 1

Ron Horton

Simon Stephen



Sites where we expected S deficiency in the surface were only marginally deficient

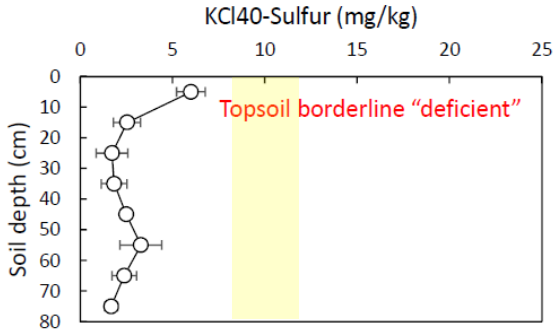
Drought may favour mineralisation, conservation and/ or retention of S

No evidence of 'bubble' of available S at depth – despite many sites having long-term history of S

2018 results

"Basalt" soil

Damian Murphy

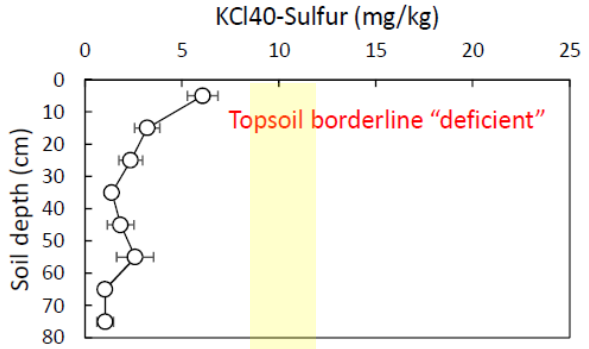


Sites where we expected S deficiency in the surface were only marginally deficient

Drought may favour mineralisation, conservation and/ or retention of S

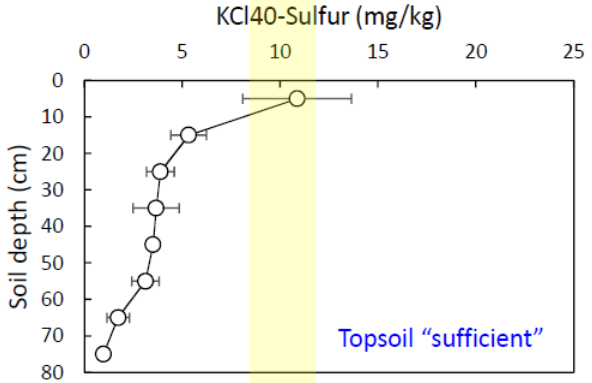
"Granite" soils

Dave Mitchell



If the surface soil result is below critical, you need to be applying S.

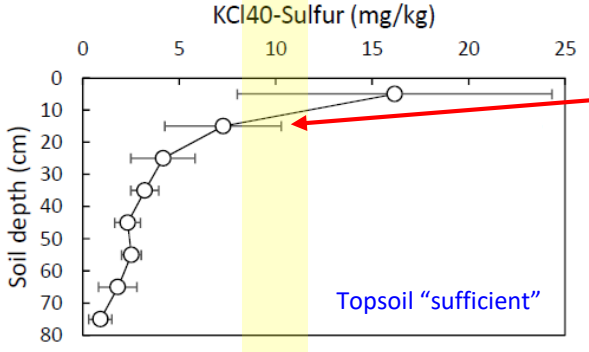
Brad Yeld



No evidence of 'bubble' of available S at depth – despite many sites having long-term history of S

Only characterised 9 soil profiles (basalts, intermediate soil types under/ not represented)

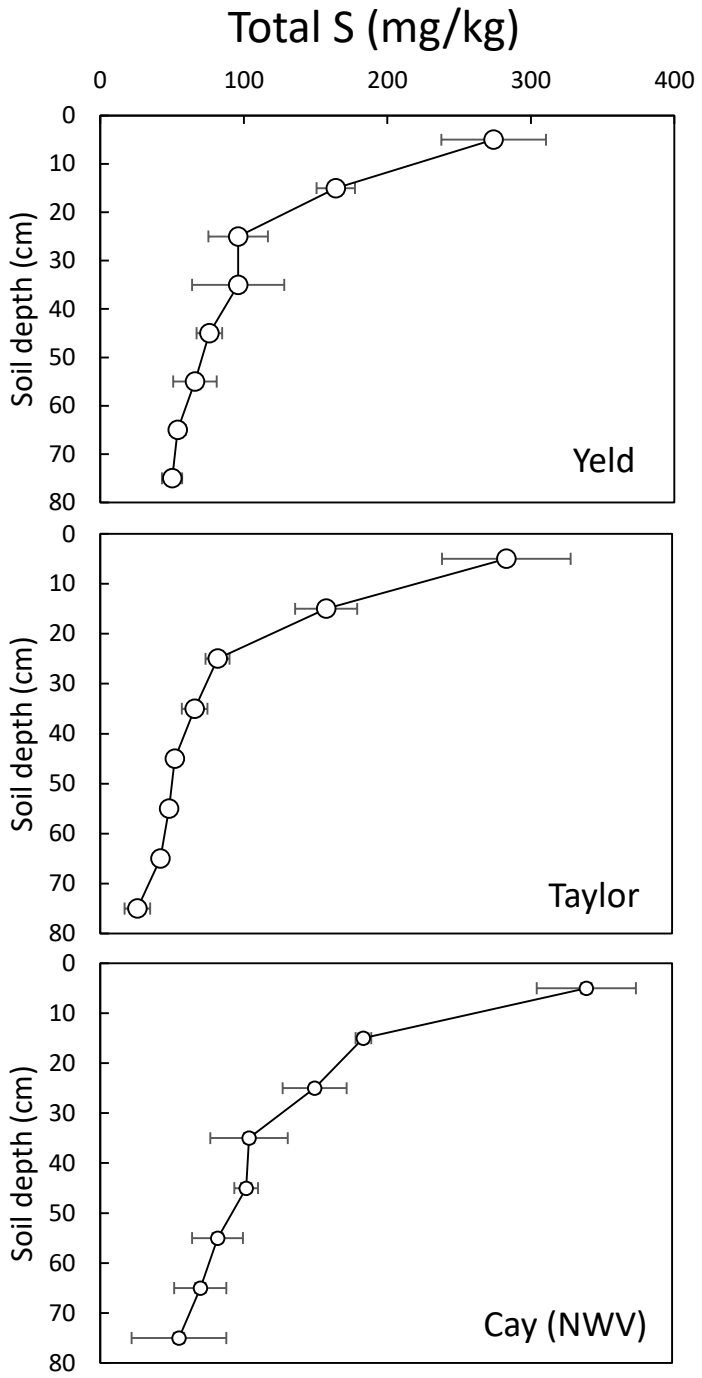
Richie Taylor



However, S is still probably moving down these profiles (e.g. when topsoil S is high, the levels in the layers immediately below the top 10 cm are also marginally elevated. However, they are often still rather S-deficient)

Where is the S going?

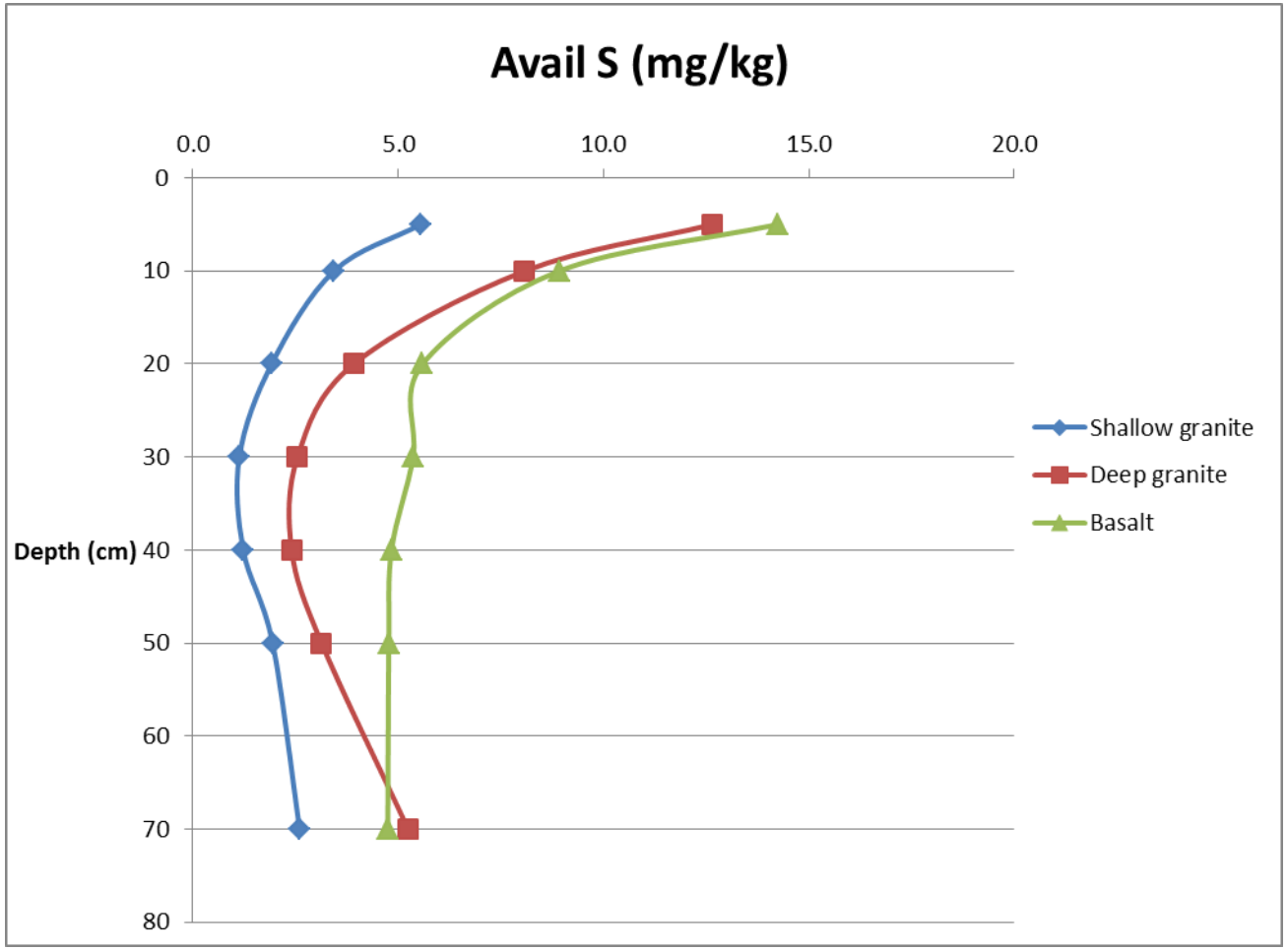
Soil depth (cm)



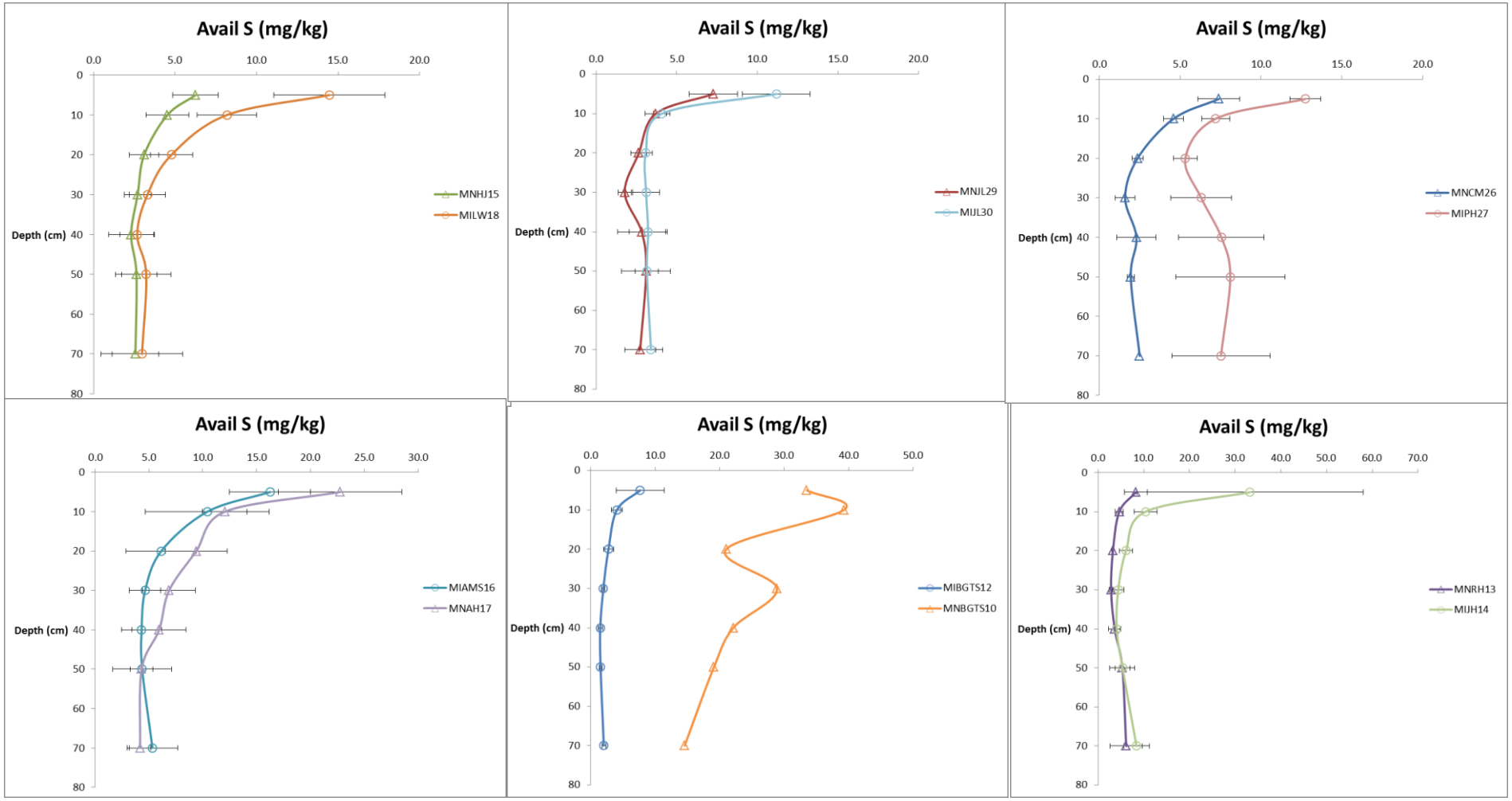
If the surface soil result is below critical, you need to be applying S.

No evidence of 'bubble' of **Total S** at depth
i.e. not accumulating in "unavailable" forms at depth

Snapshot


Avail S (mg/kg)
0.0
5.0
10.0
15.0
20.0
0
10
20
30
40
50
60
70
80
Depth (cm)
Shallow granite
Deep granite
Basalt

Basalt



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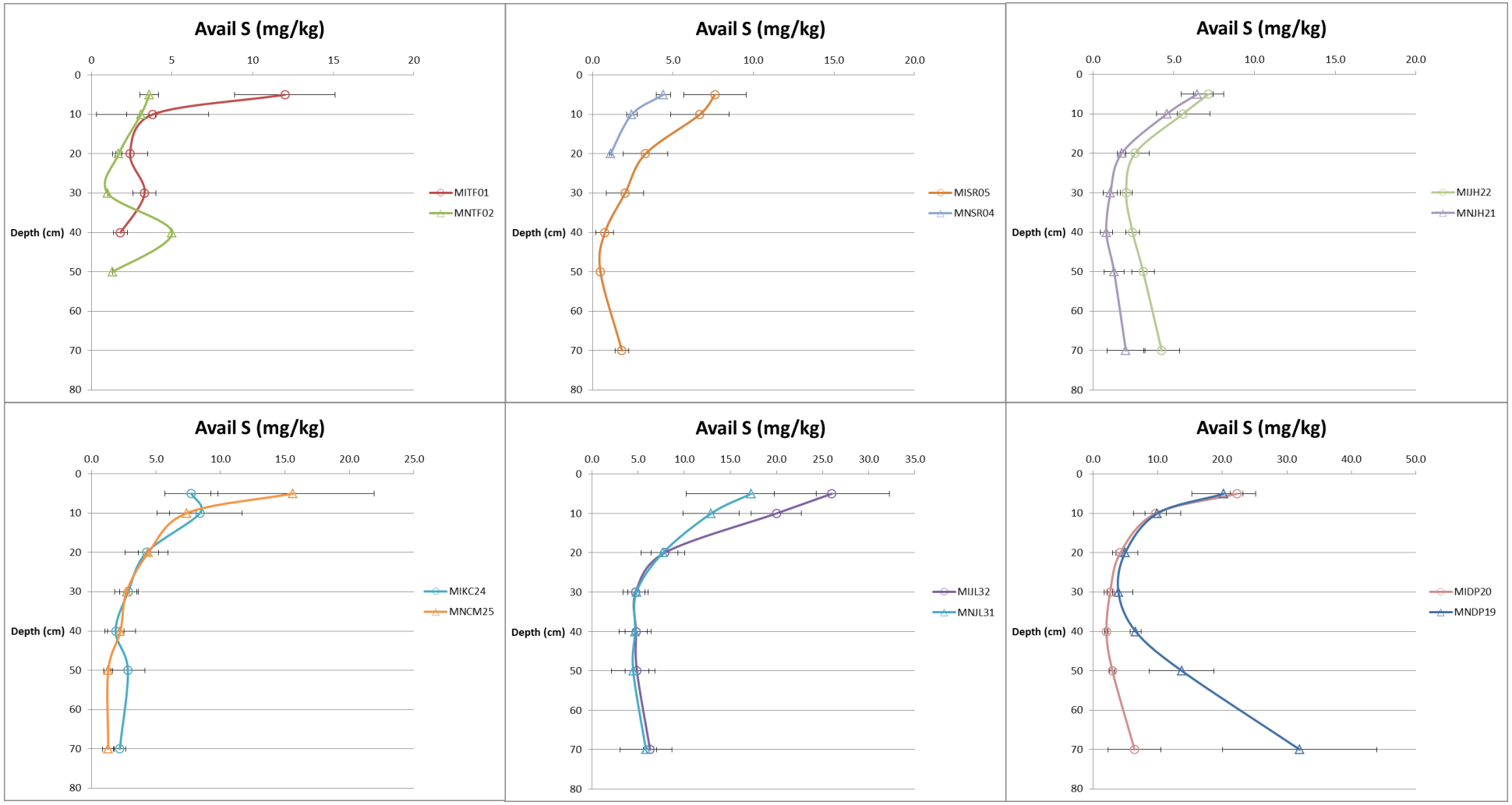
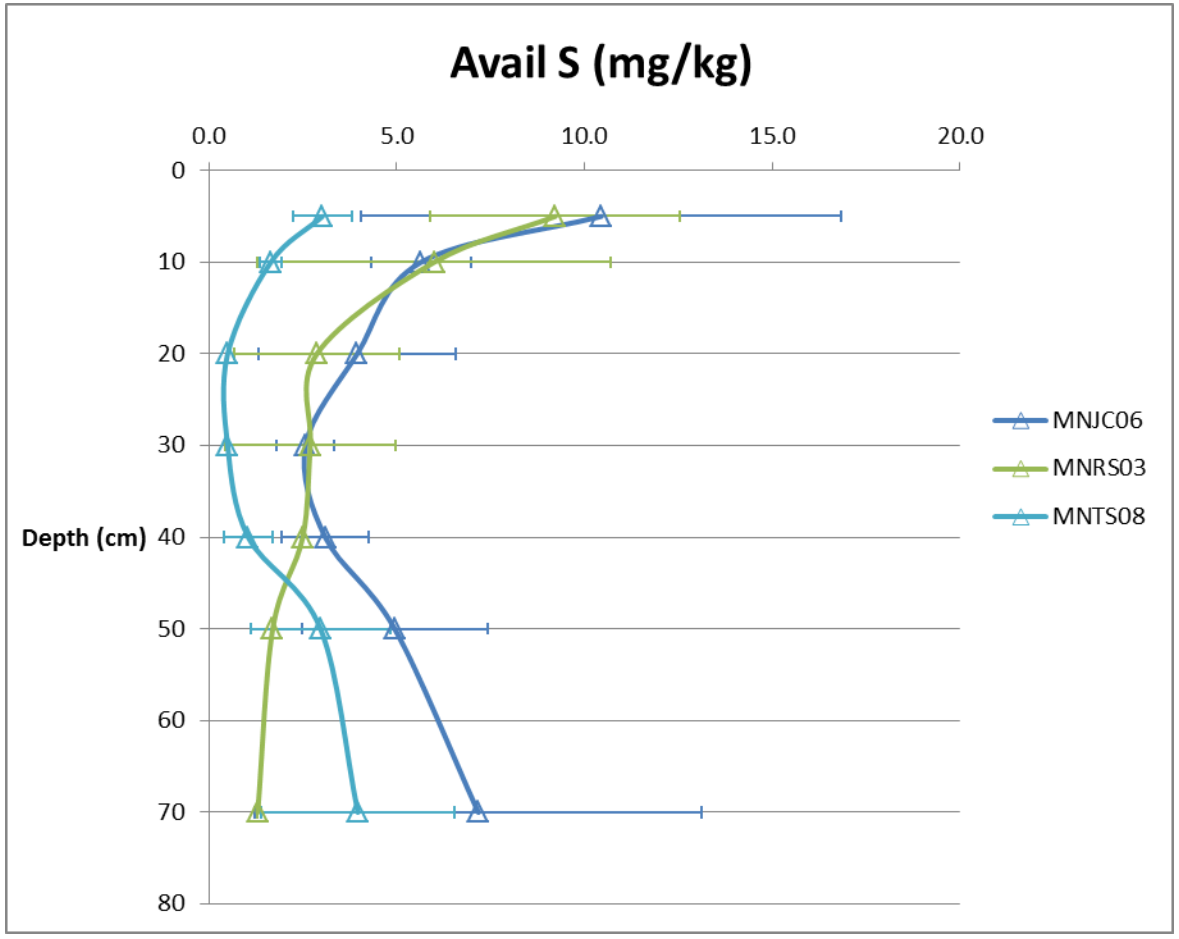
Australian Government | National Landcare Program

Deep granite



Shallow granite



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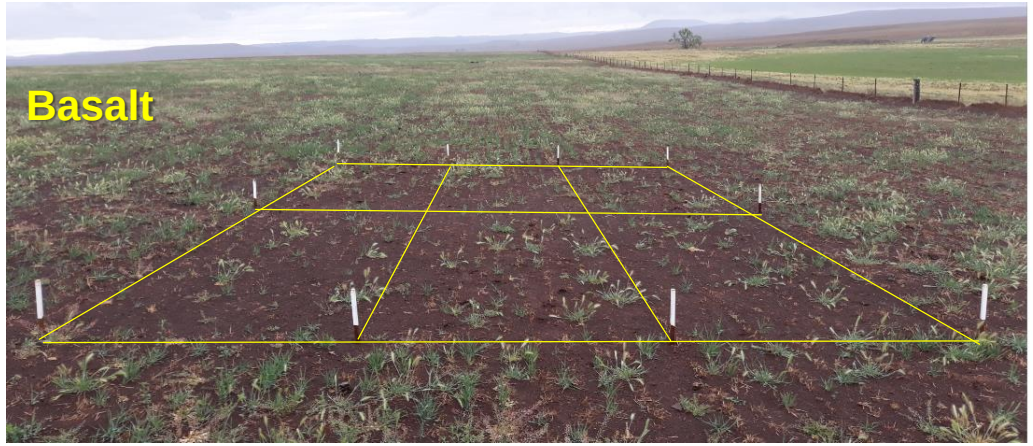
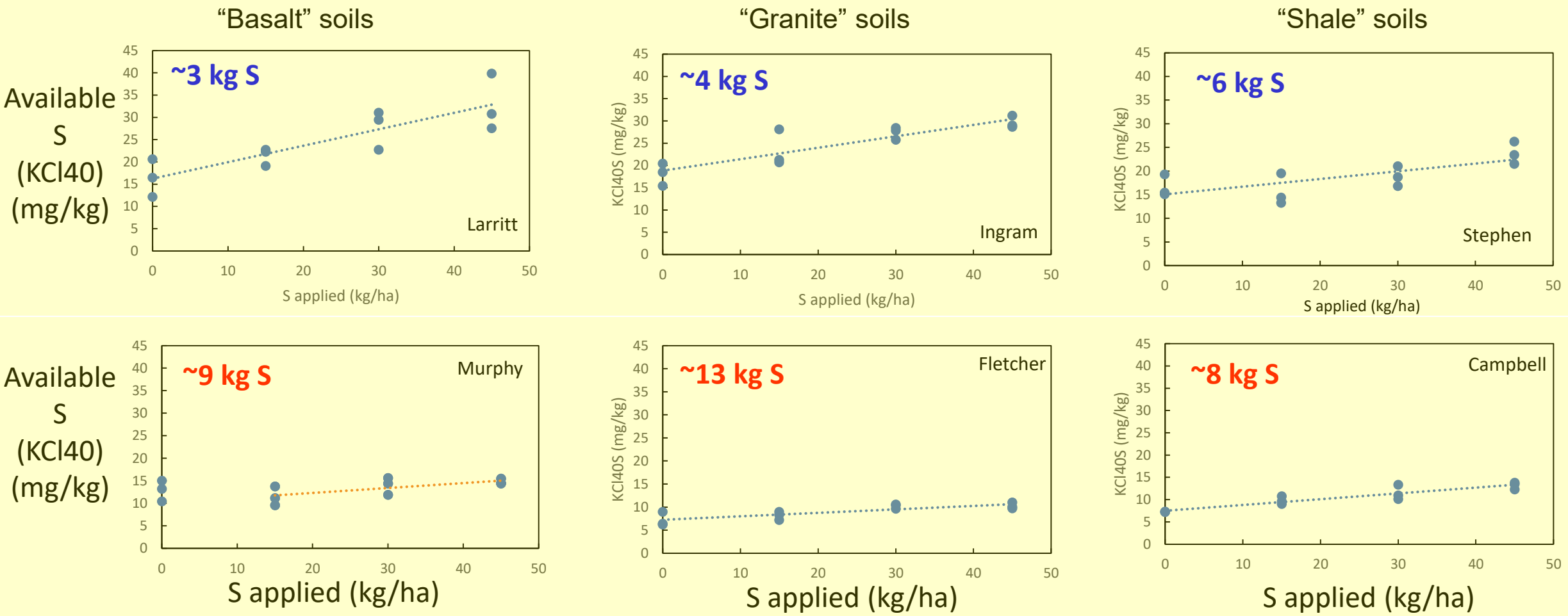
Pasture response to S application



- 2018 and now 2019 seasons very dry
- only 2 of the 15 sites harvested in 2018

Change in KCl40 soil test value per unit S applied varied across the sites

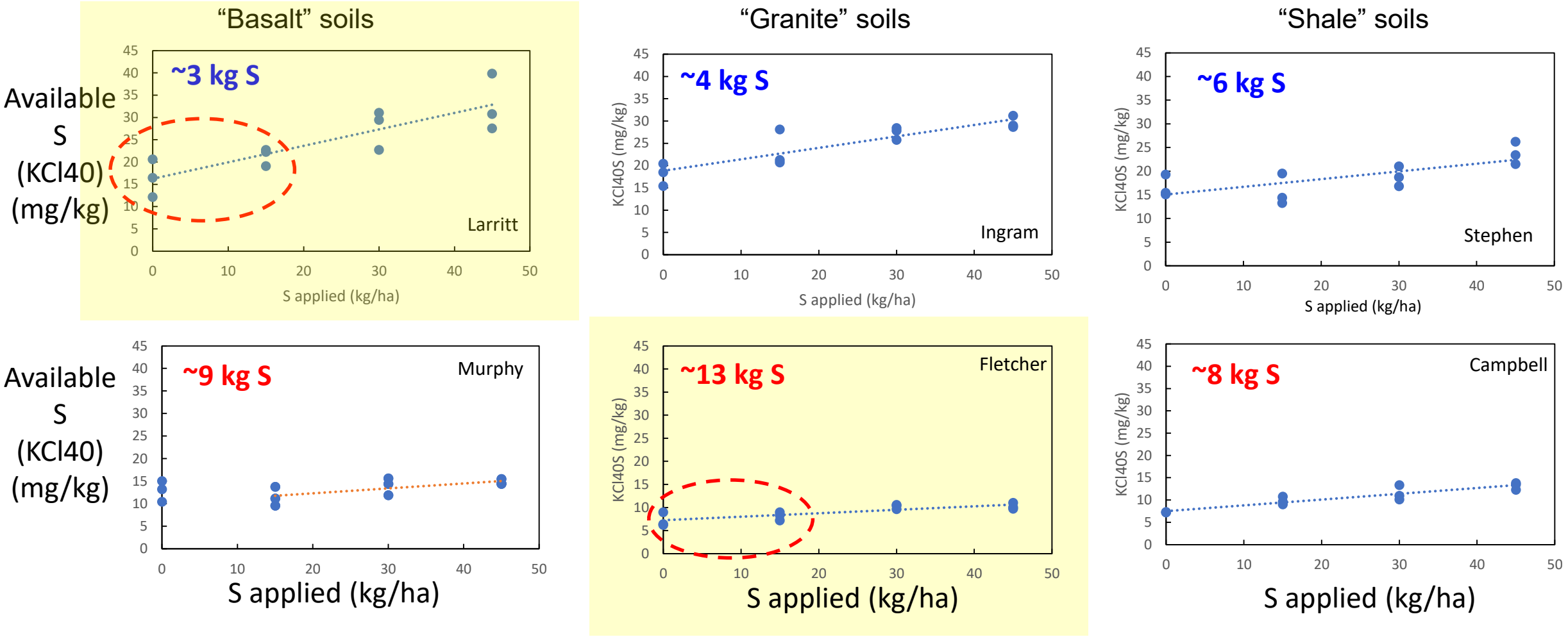


Soils with higher starting values tended to be more responsive i.e. require less S to increase the soil test value by 1 unit

Soils with lower starting values tended to be less responsive i.e. require **a lot** of S to increase the soil test value by 1 unit

These are preliminary findings → they need to be confirmed under "normal" seasonal conditions

What do these results tell us about S fertiliser management and soil testing?



If we apply 150 kg single superphosphate/ha (~10% S i.e. 15 kg S/ha) ….

- on some soils, responses to S are so flat that it would not shift the KCl40 S test value very much i.e. need to apply a lot of S
- Even at more responsive sites, the ability to measure a change in KCl40 test value from 15 kg S/ha is still limited
- Like P, ongoing monitoring to look at trends is the only way to estimate the available S status

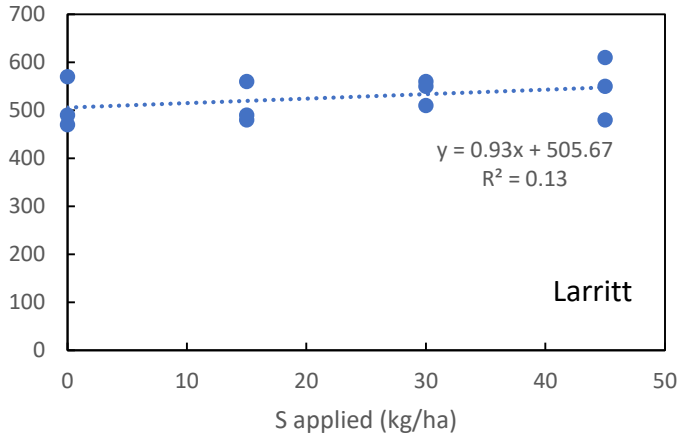
Where is the S going? Is sulfur accumulating in other soil fractions?

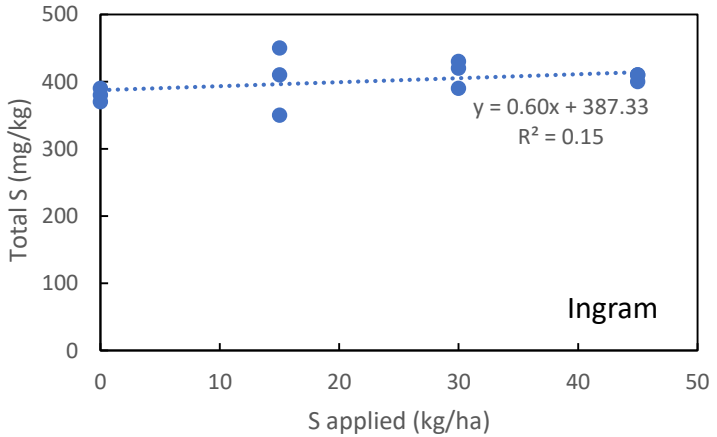
"Basalt" soils

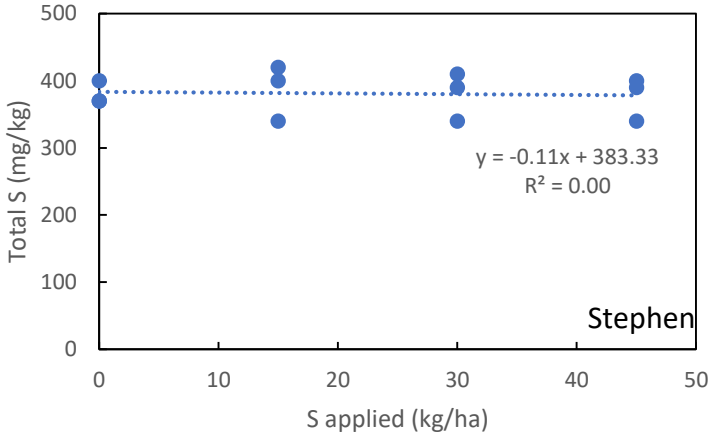
"Granite" soils

"Shale" soils

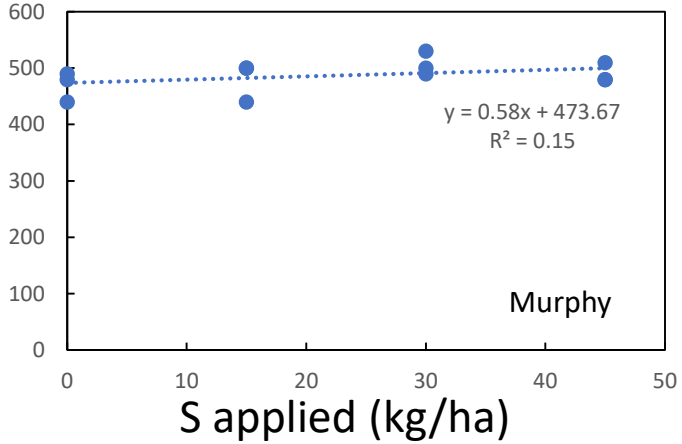
Total S (mg/kg)

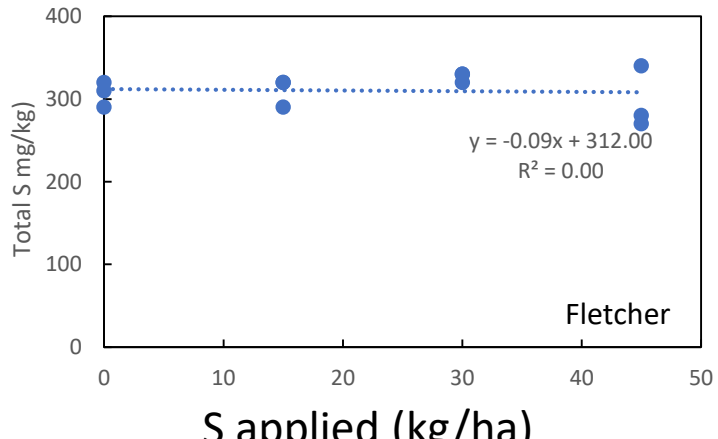


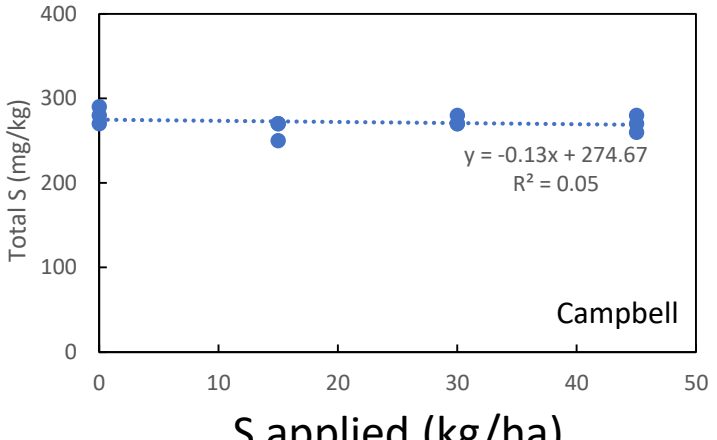




Total S (mg/kg)







S applied (kg/ha)

S applied (kg/ha)

S applied (kg/ha)

Response of 'Total S' to S application was effectively flat

trying to detect an equivalent of 15 to 45 mg S/kg applied to a background of 300 to 500 mg S/kg

→ represents between a 3% and 15% change in total S → method is not sensitive enough to detect this

→ require radioisotope work to track where applied S is going in the soil ("unavailable pools", movement down profile)

Take home messages…

1. **Deep soil nutrient profiles**

   → *we did not observe a 'bubble' of available S at depth*
   → *surface S test is likely indicative of S fertility → base S applications on surface test results*

2. **Pasture response to S-fertiliser**

   → *unable to confirm whether surface test indicative of S response*
   → *maintain sites beyond project …*

3. **Soil test response to gypsum**

   → *KCl40 soil test response to S application was often very shallow*
   i.e. S has been applied but is not detectable in the 'available' pool after 6 months
   → *appear to get less of a response in KCl40 soil test in soils with lower S status*
   → *ability to measure changes in KCl40 test value with quantities of S being applied is limited (need monitoring)*

Caveats: these are <u>preliminary findings</u> under <u>drought conditions</u>

Where to next…

1. **Radioisotope work to trace where the S is going and how “available”**
2. **Further work to understand variability of KCl40-S soil test**

National

'P-efficient pastures'

project

Co-funded by:

Dept of Agriculture and Water Resources

(Rural R&D for Profit program)

Meat and Livestock Australia,

Dairy Australia

Australian Wool Innovation Ltd,

& the collaborating research and farmer organisations.

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