My field study – theoretical framework & outcomes

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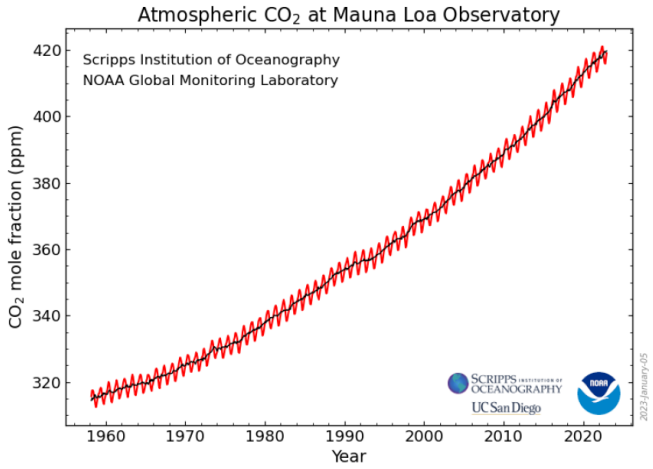
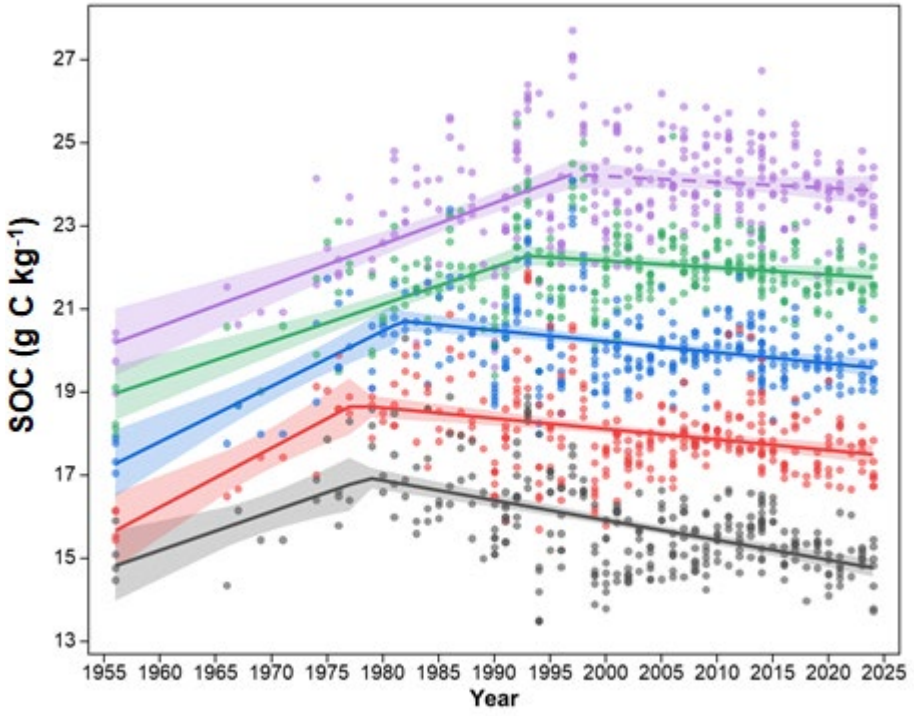
Objective: soil organic carbon accrual

Soils store a lot of C (2300 Gt C, 3m)

Intensive land use → long term SOC decrease



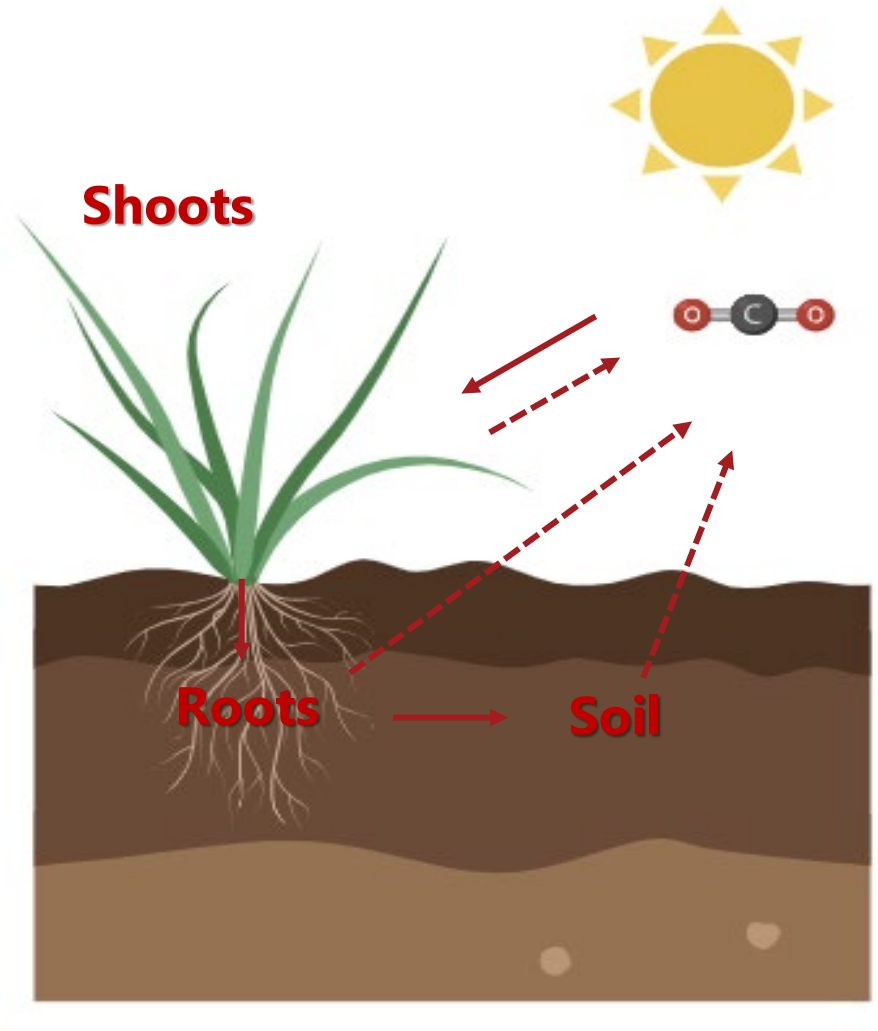


From Shang Wang et al, In prep.

Soil organic carbon accrual

- ✓ Can help mitigate climate change
- ✓ Can improve soil functions
- ✓ Can increase farmer's income

Pathway of C to soil



Main processes

Photosynthesis

Storage and translocation

Losses

Soil C storage = C input − C output

PhD project

- ❑ Goal: explore genetic variability of forages for their potential to add carbon to the soil → root phenotyping
- ❑ Species used: perennial ryegrass, tall fescue, festulolium, chicory, plantain

Experiments:

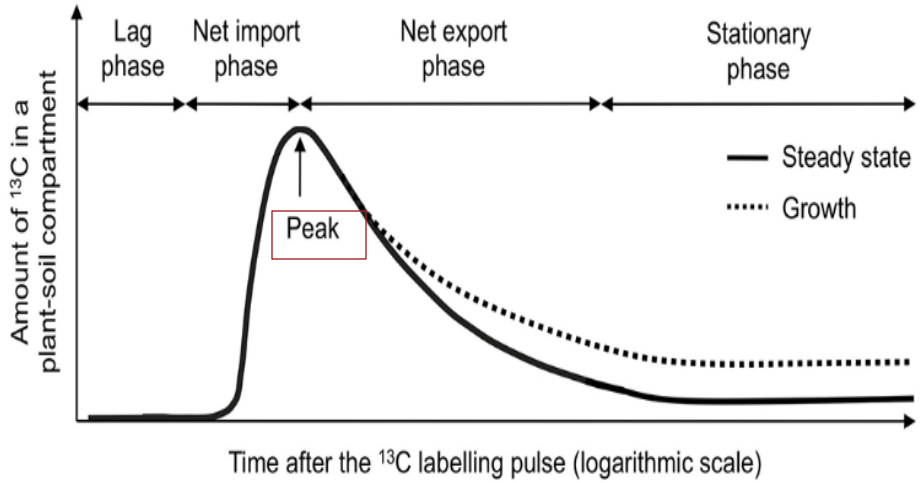
$^{13}CO_2$ field study

Image analysis

Root to shoot ratio

Field study

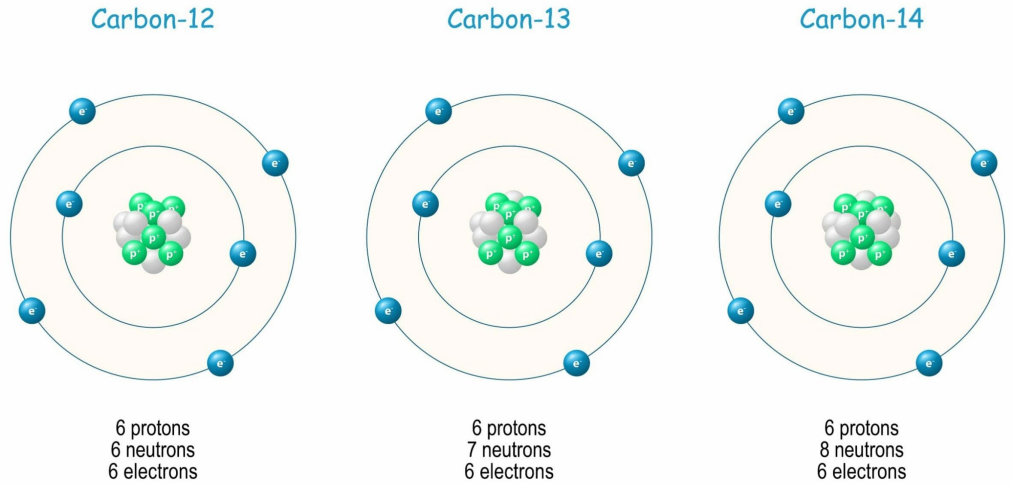
Objective: compare grasses for their capacity to allocate fresh C belowground, over the short term.



From Studer et al, 2014

{Carbon isotopes as tracers}

Why give CO2 when there is plenty in the atmosphere?



Relative abundance

98.9% 1.1% traces

Labelling setup

HCl

$\mathbf{C}O_2$

$NaH\mathbf{C}O_3$

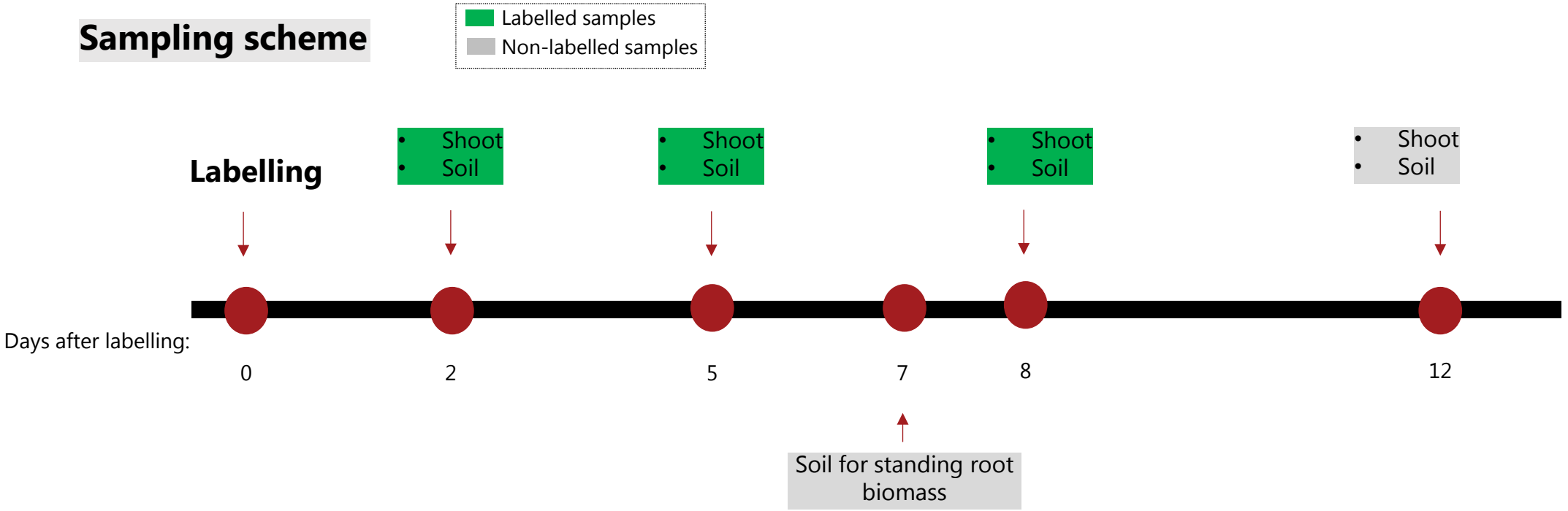
(+)Follow movement & fate of C from photosynthesis
(+)Distinguish recent plant-derived carbon from pre-existing carbon

(-) High purchase and analytical costs
(-) 14C strict safety regulations

Field - 2024

- Species differences
- Single pulse of $^{13}CO_2$ in May
- Assimilated over 90 min
- Sampling at 2, 5 and 8 DAL

Sampling scheme



Field 2024

Shoot samples

✓ Dried, milled, packed, sent to the lab

Soil samples (labelled & controls)

✓ Dried, stones removed, milled, carbonate removal, packed, sent to the lab

✓ Includes roots!

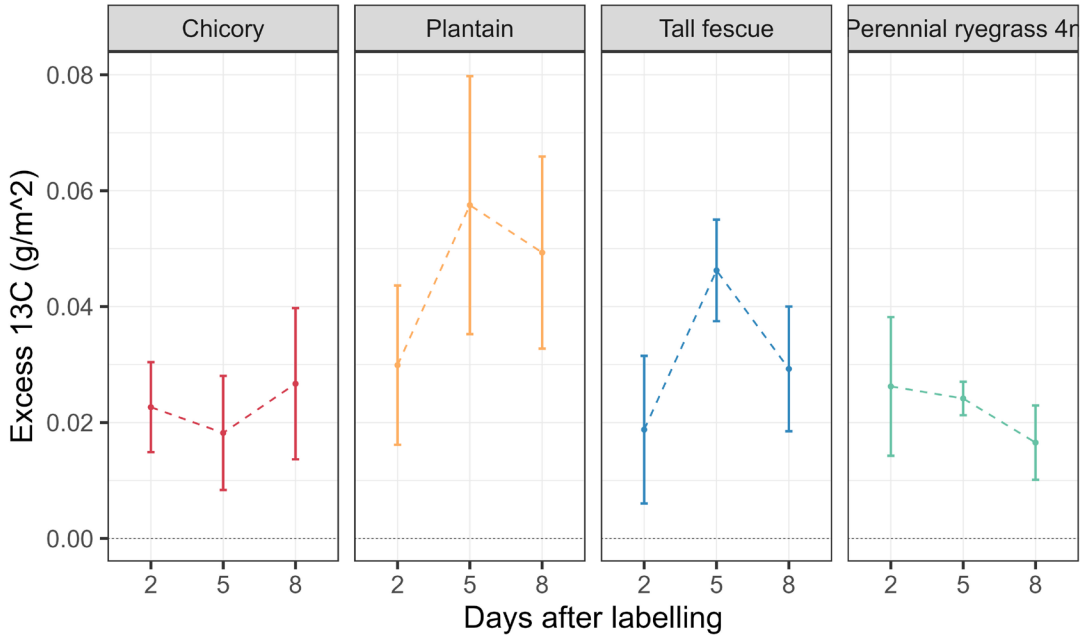
Soil samples (for standing root biomass)

✓ Roots isolated, dried, weighed

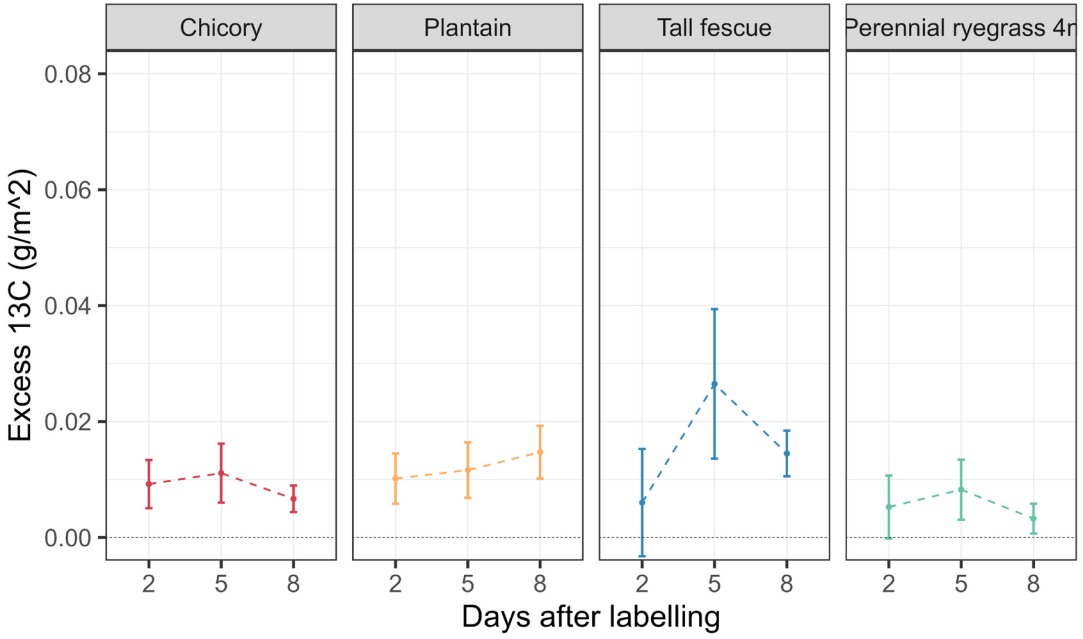
Field 2024

Results

0-25 cm

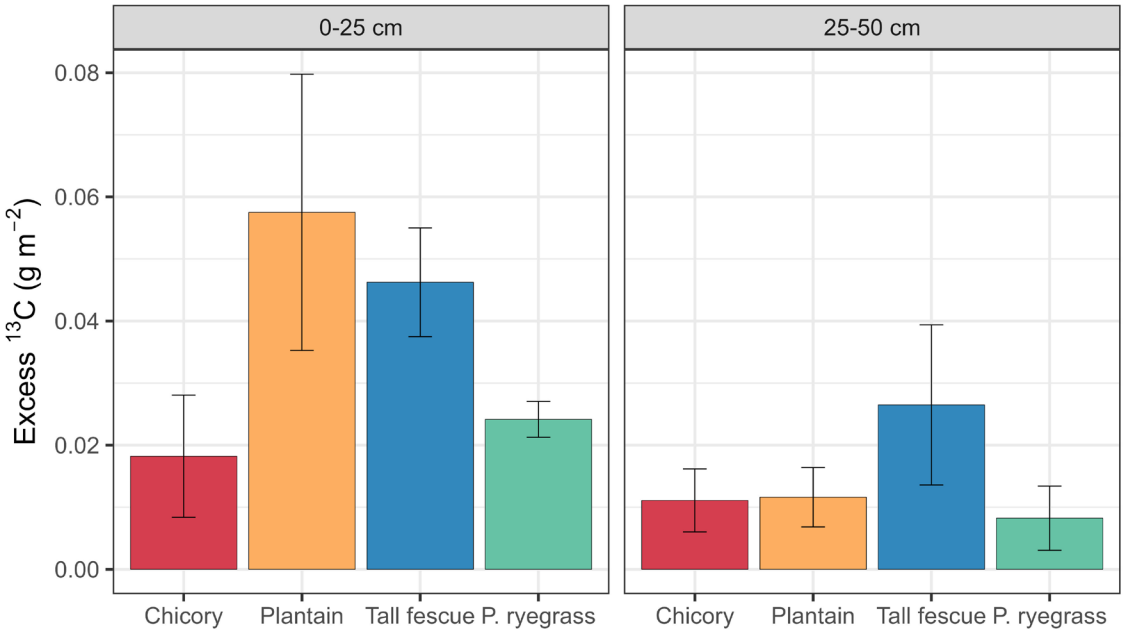


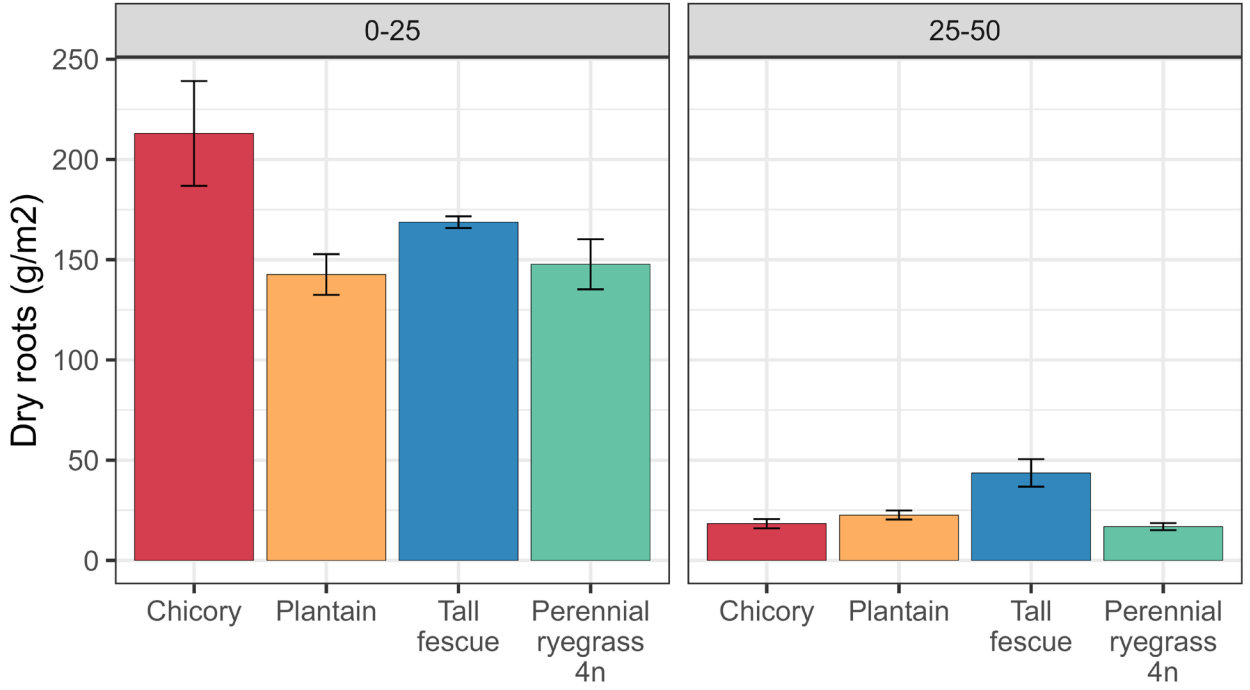
25-50 cm



Field 2024

Results

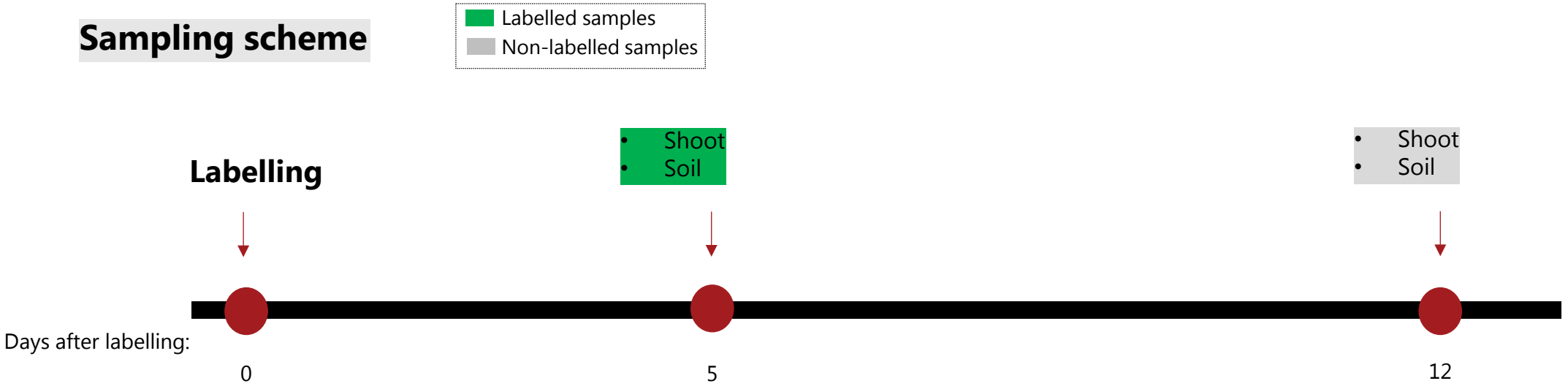




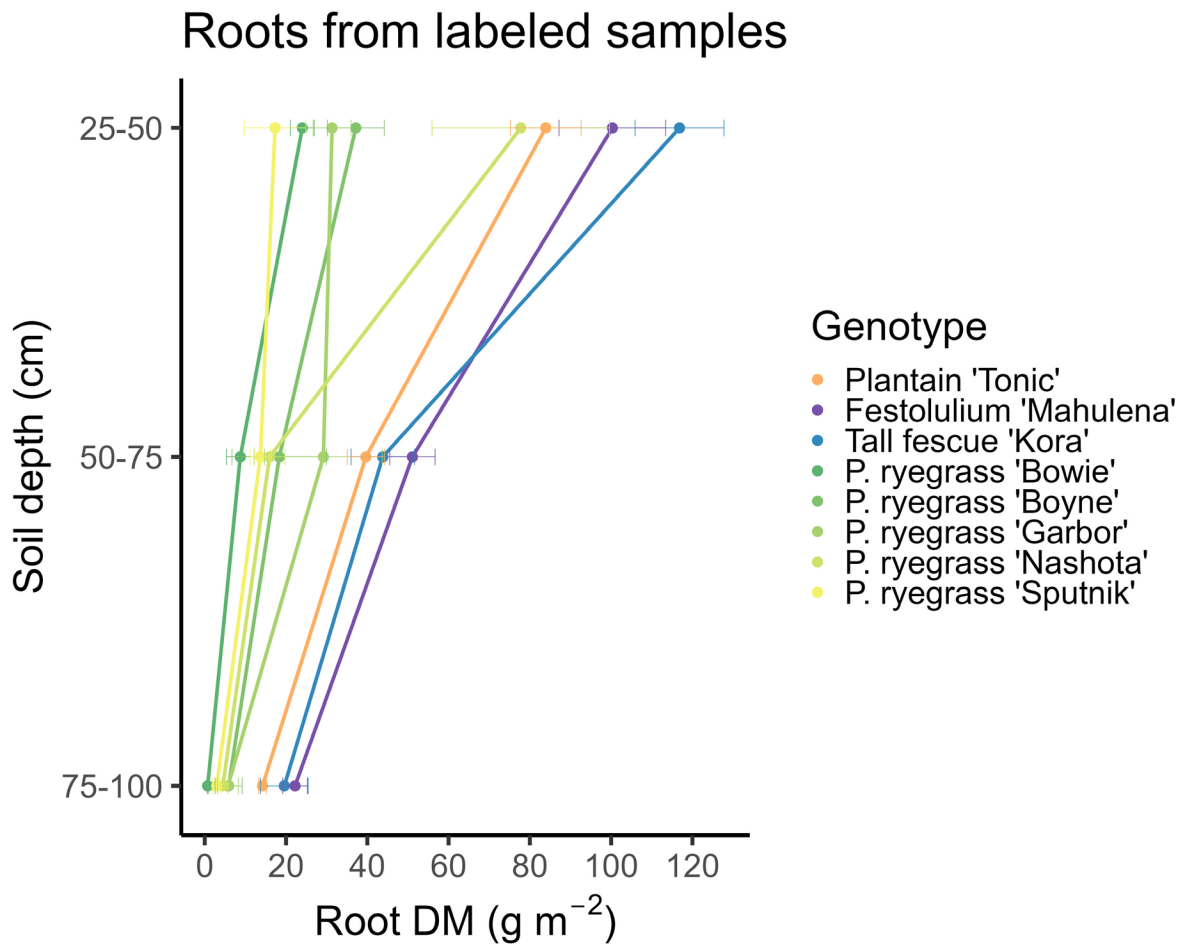
Field - 2025

- Cultivar differences (+species)
- Single pulse of $^{13}CO_2$ in May
- Assimilated over 90 min
- Sampling 5 DAL

Sampling scheme



Field 2025


Roots from labeled samples
Soil depth (cm)
25-50
50-75
75-100
0
20
40
60
80
100
120
Root DM (g m^{-2})
Genotype
Plantain 'Tonic'
Festolulium 'Mahulena'
Tall fescue 'Kora'
P. ryegrass 'Bowie'
P. ryegrass 'Boyne'
P. ryegrass 'Garbor'
P. ryegrass 'Nashota'
P. ryegrass 'Sputnik'

Thank you ❤