Uncovering cover crop mixture root abundance and composition to maximize ecosystem service provisioning

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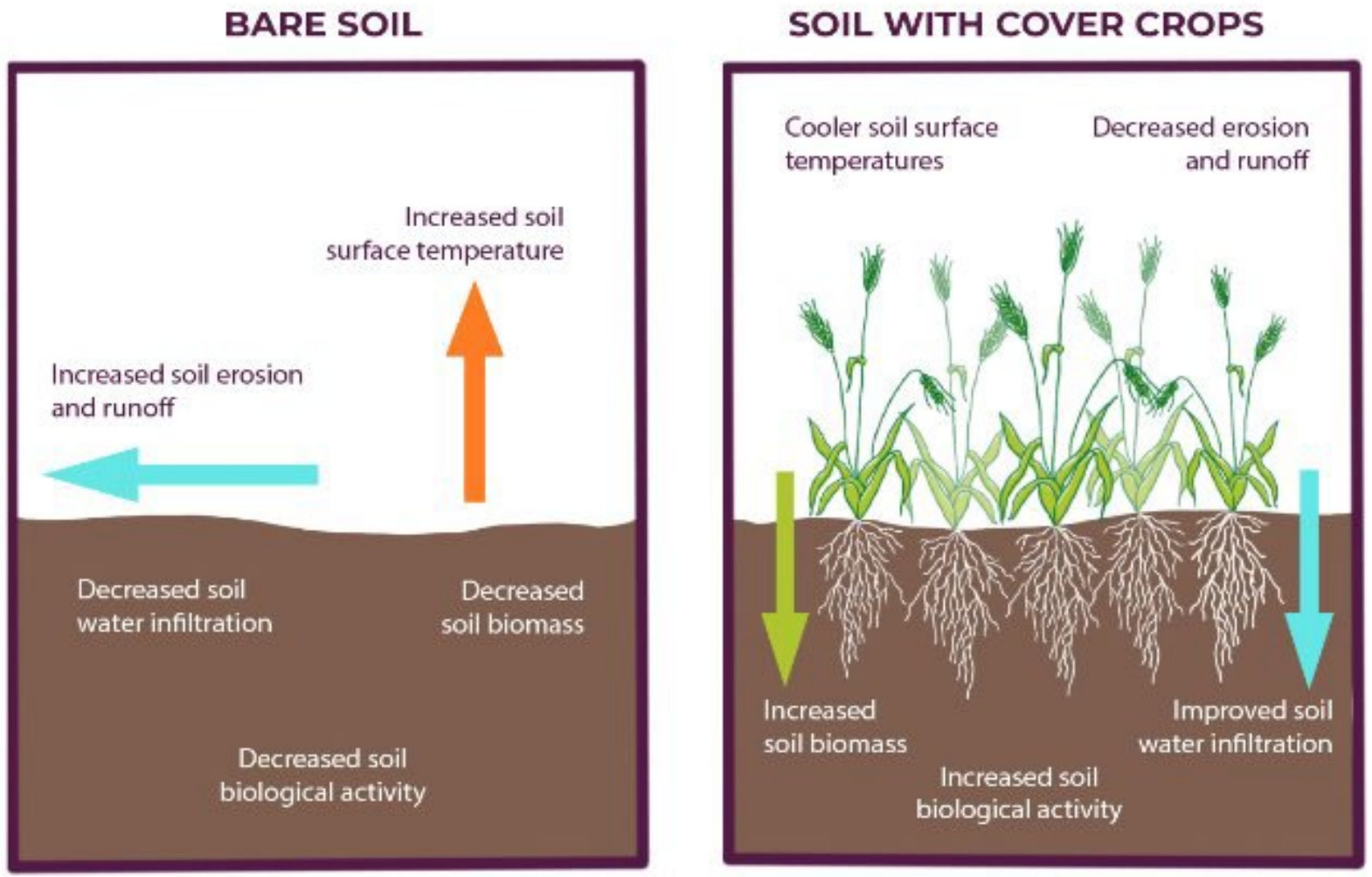
Cover crops are a critical tool in sustainable agriculture



Decode 6

Each cover crop functional group provides unique ecosystem services and disservices

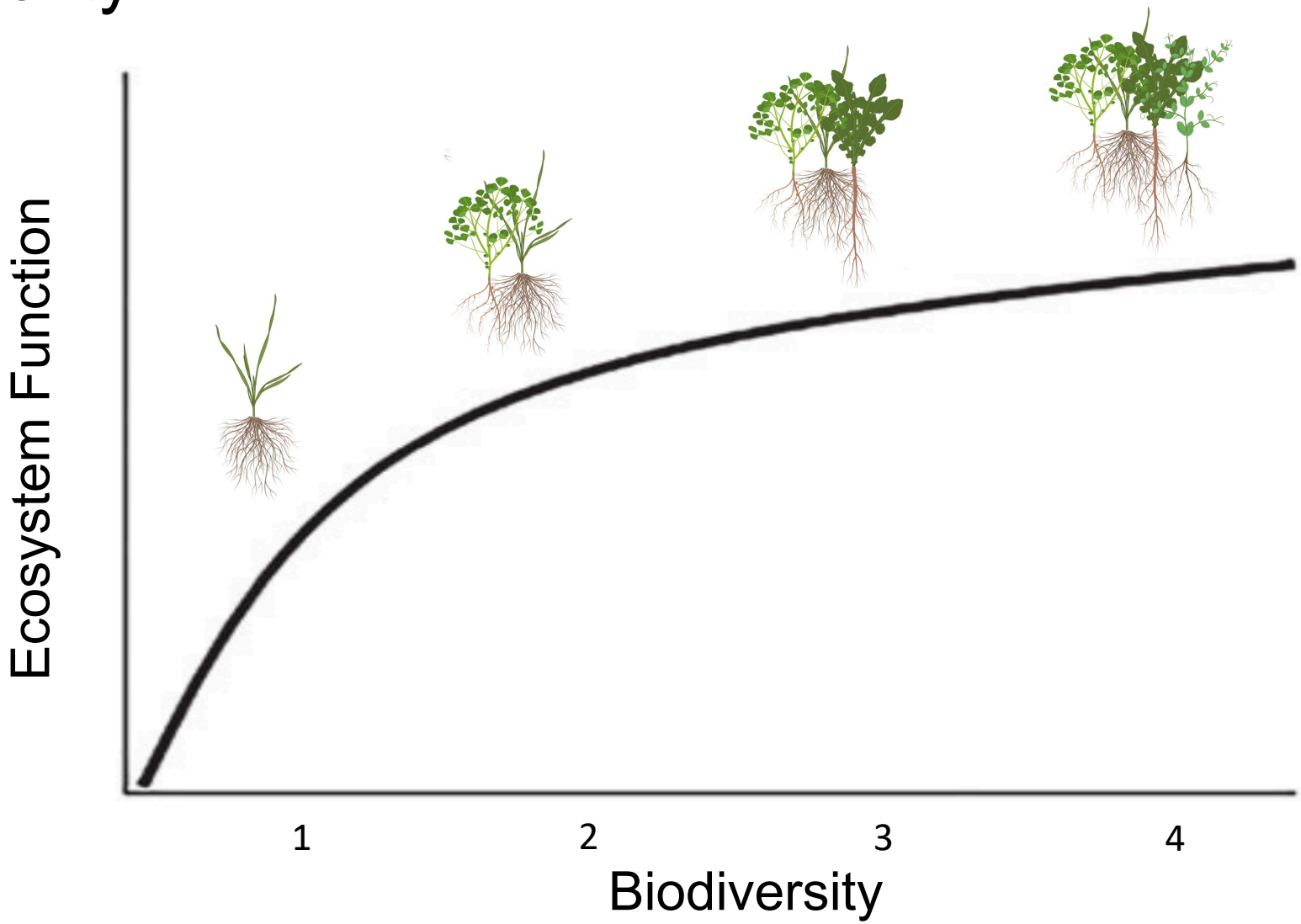
Brassica

Grass

Legume

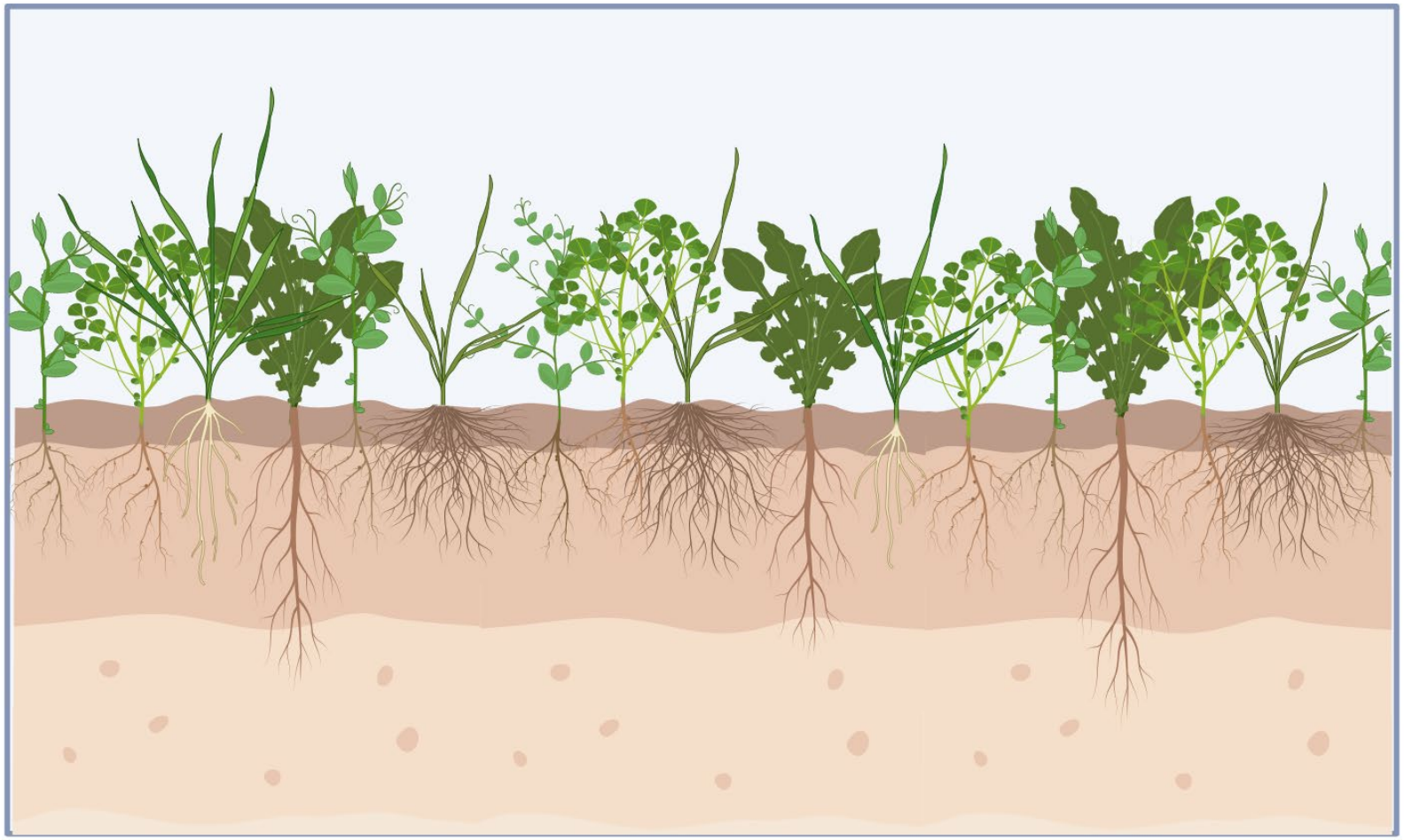
Brassica	Grass	Legume
Services: + Reduce soil compaction + Retain deep soil N	Services: + Weed suppression + Retain residual N	Services: + N fixation + Provide substantial N to subsequent crop
Dis-services: − No AMF associations − Increase slug pressure	Dis-services: − Hinders crop establishment − Immobilize N	Dis-services: − Poor weed suppression − Poor at scavenging N

Cover crop mixtures increase biodiversity and ecosystem functionality



To design better mixtures we need to look belowground

Many ecosystem services of interest to growers are tightly linked to roots and the rhizosphere



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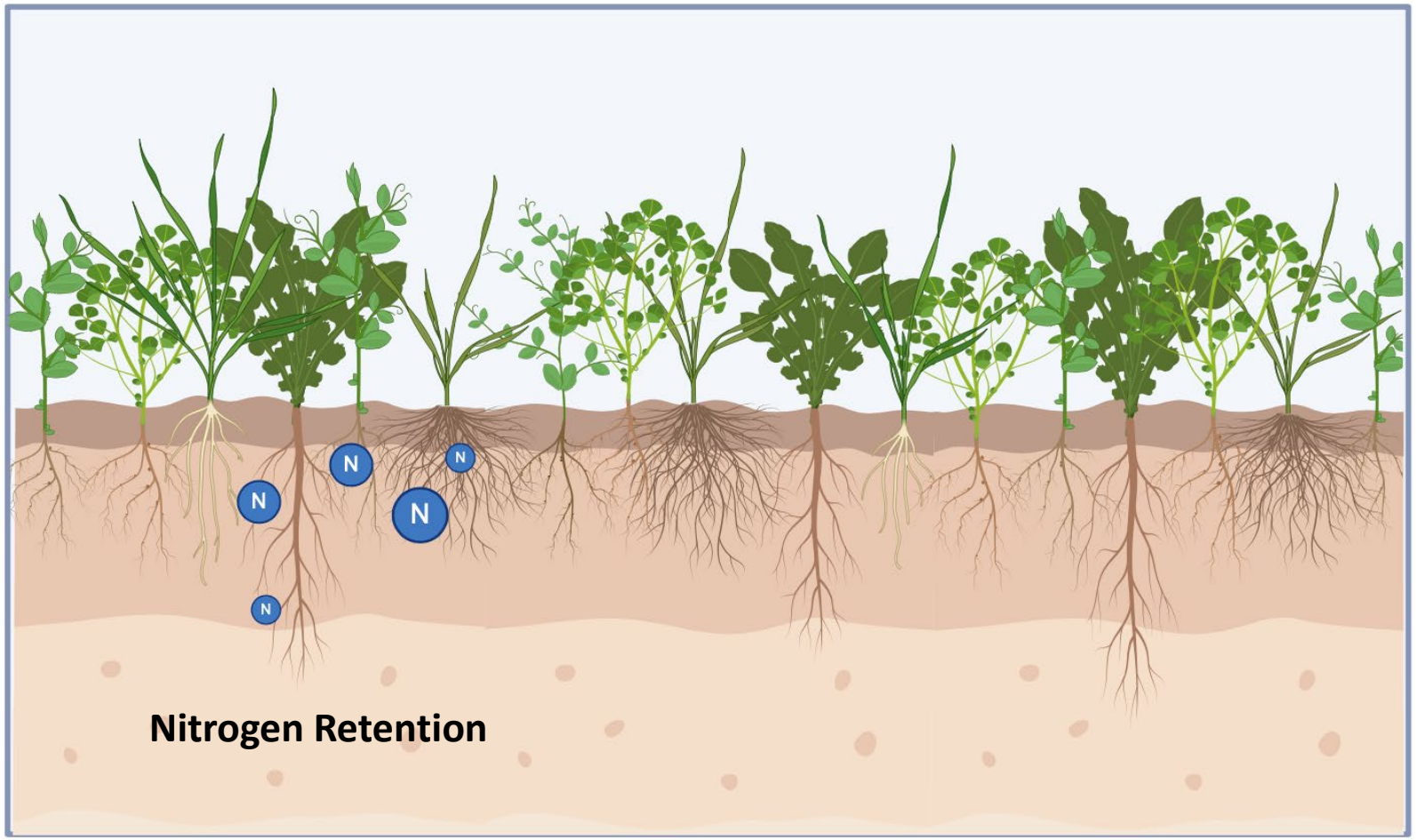

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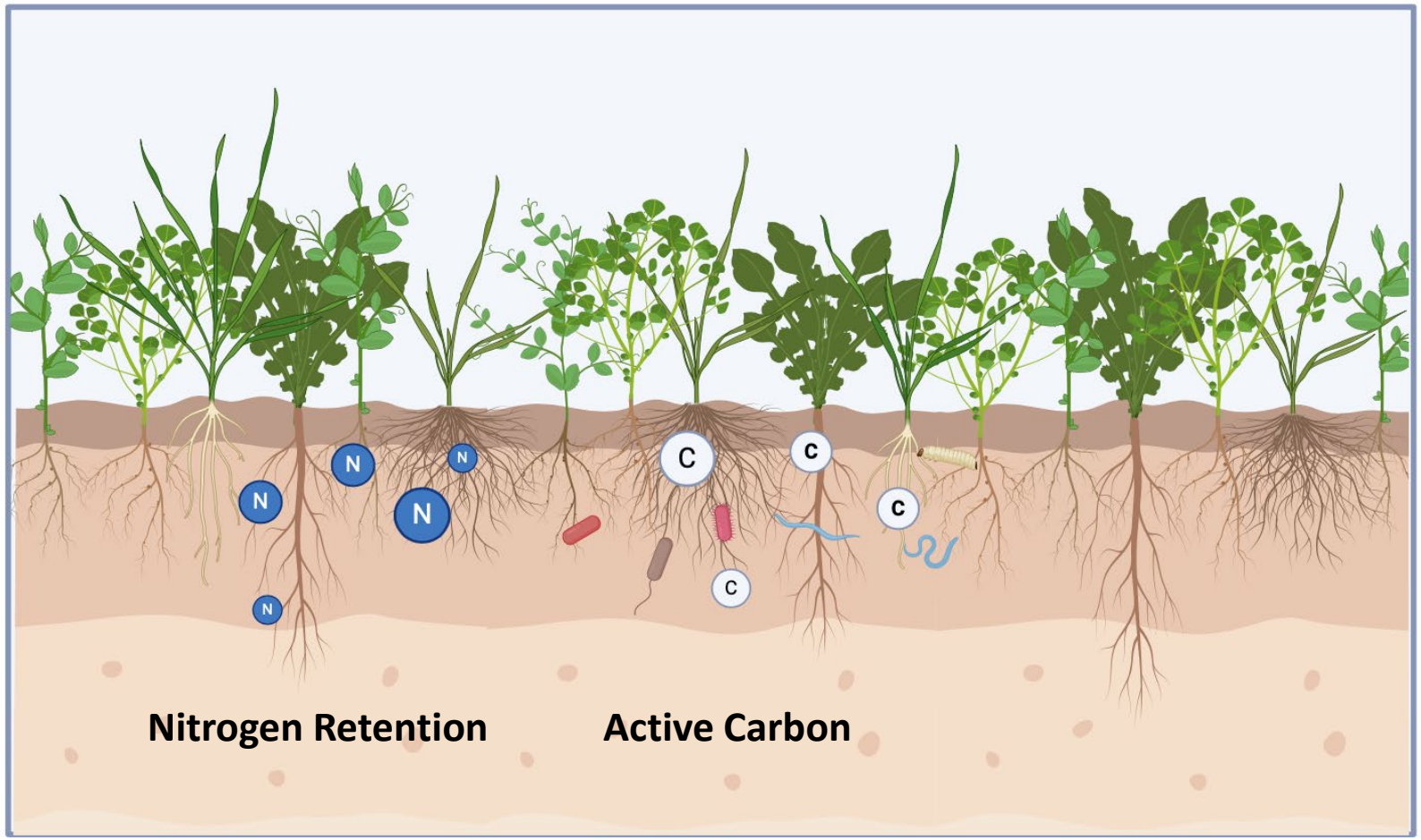

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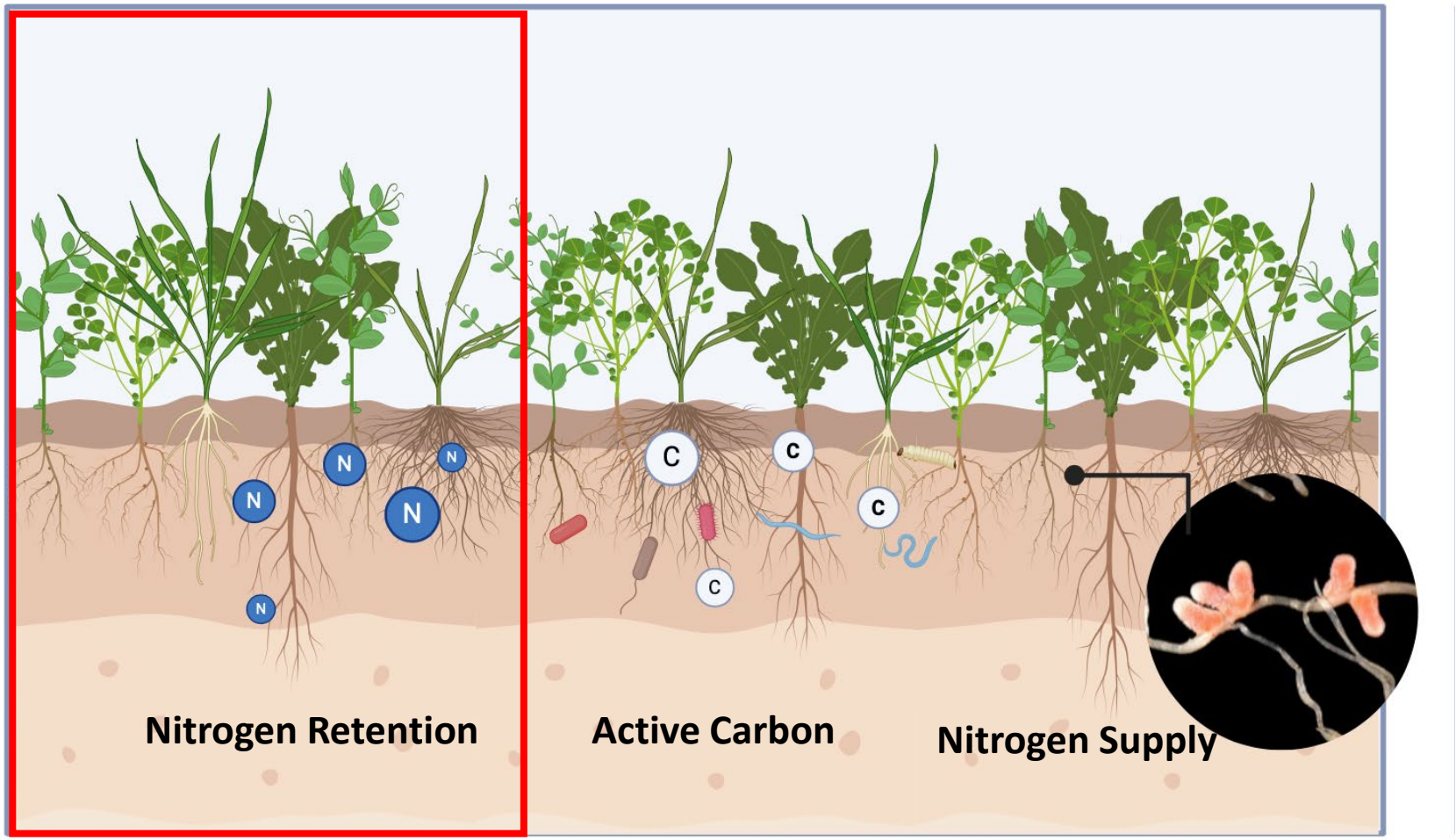

Research Questions

1. How do species alter their biomass allocation between mixtures and monoculture treatments?

2. Does including cover crop mixture root composition improve nitrogen leaching predictions?


1
2
3
4
Cover crop treatments
Soybean
Corn
Slide by Kelsey Mercurio

Field Treatments

Crimson Clover

Winter Pea

Triticale

Canola

4 species mixture

Shoot and Root Sampling

(reporting on 3 years of fall data)

Soil Sampling

(deep soil N)

Soil core to 80cm

+ Fallow Treatment

Research Questions

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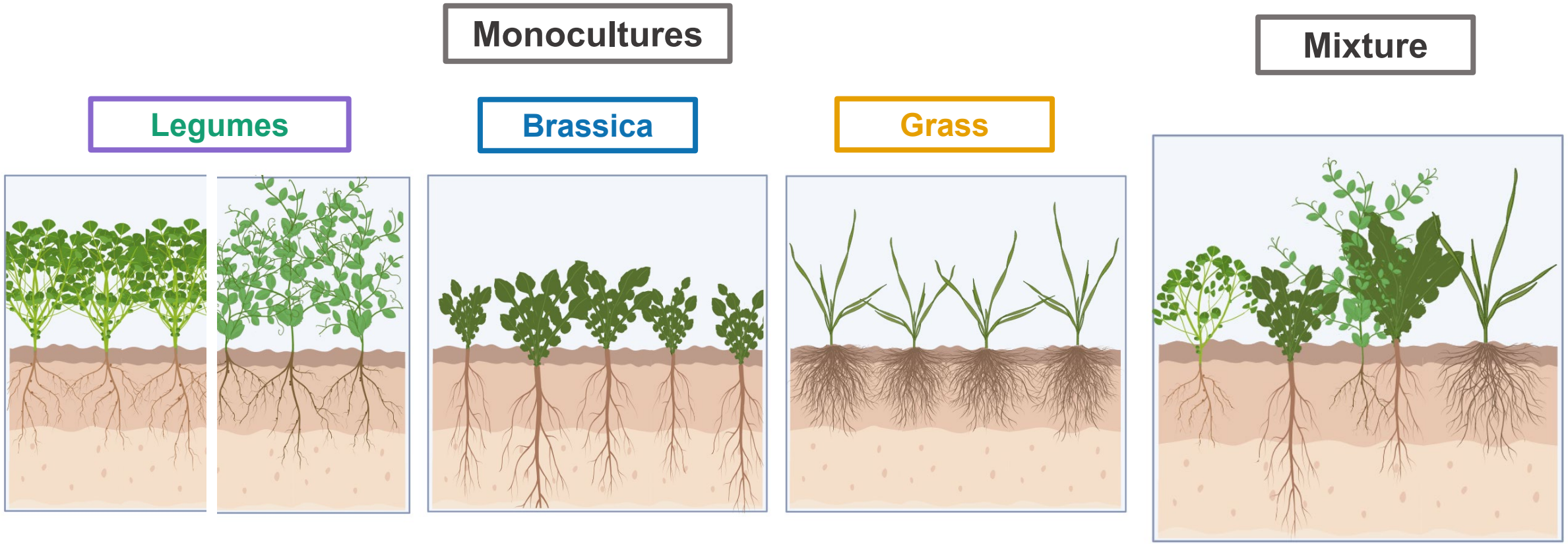
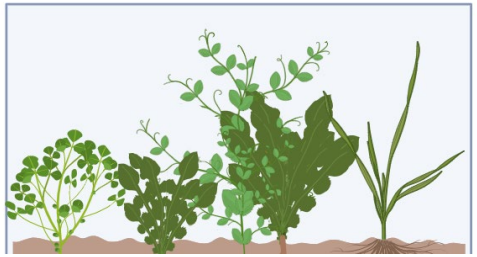
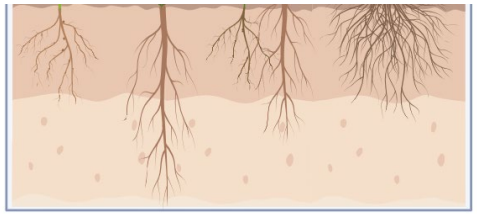
Hypothesis:

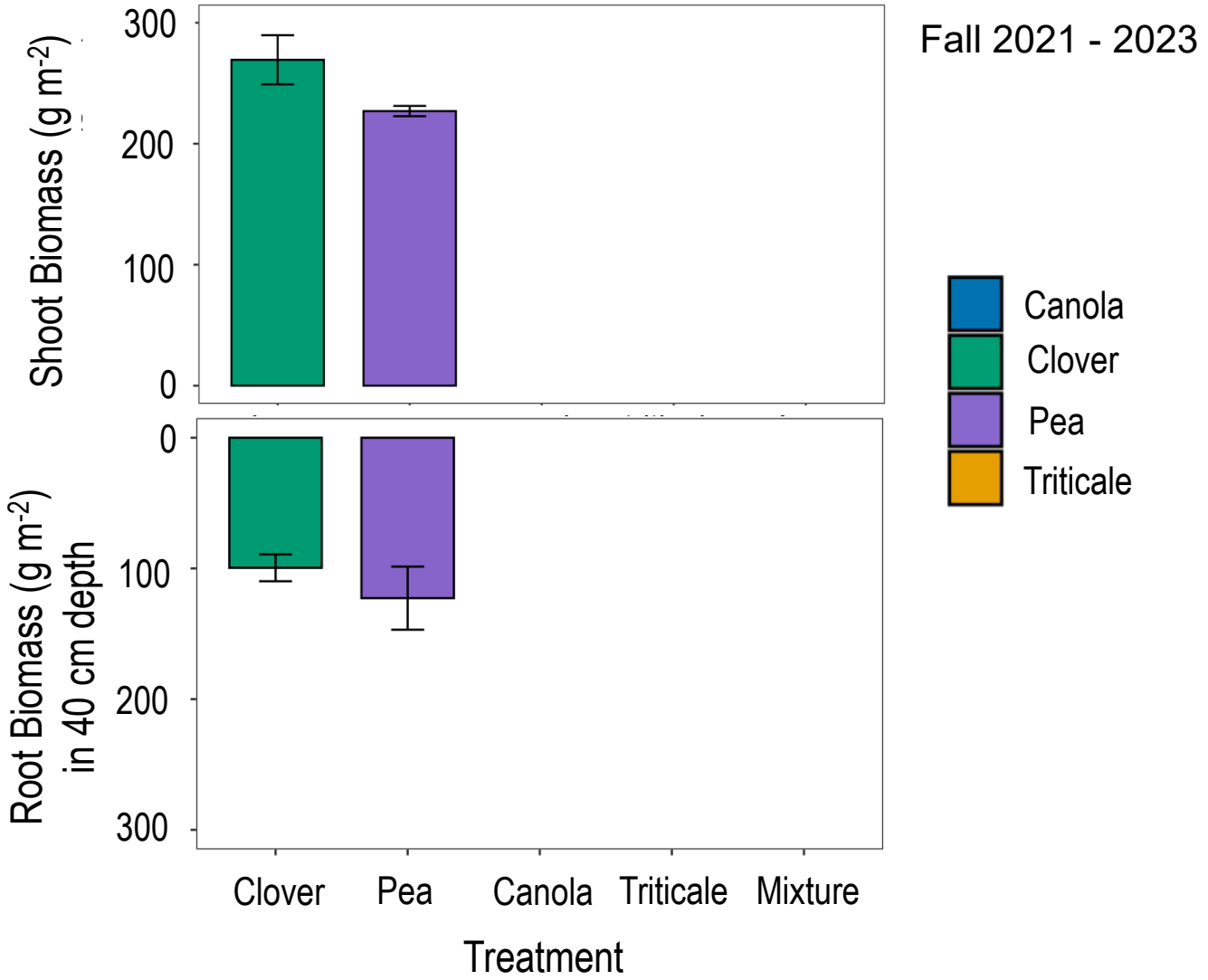
cover crops will adjust their biomass allocation in mixture



Species have different root to shoot biomass distribution

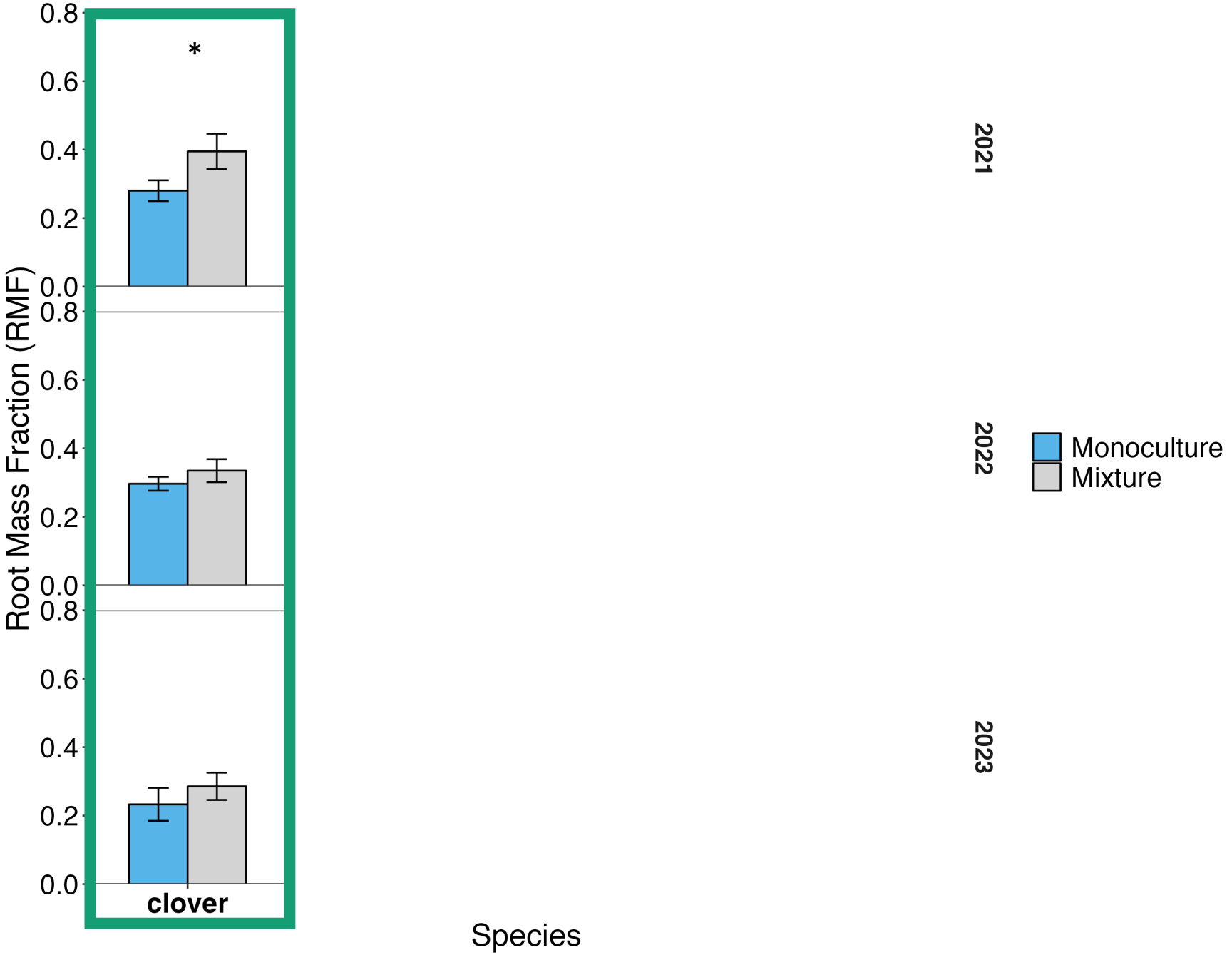






Above vs. belowground biomass varied in mixture for each species across years

$$RMF = \frac{Root\ Biomass}{Shoot + Root\ Biomass}$$



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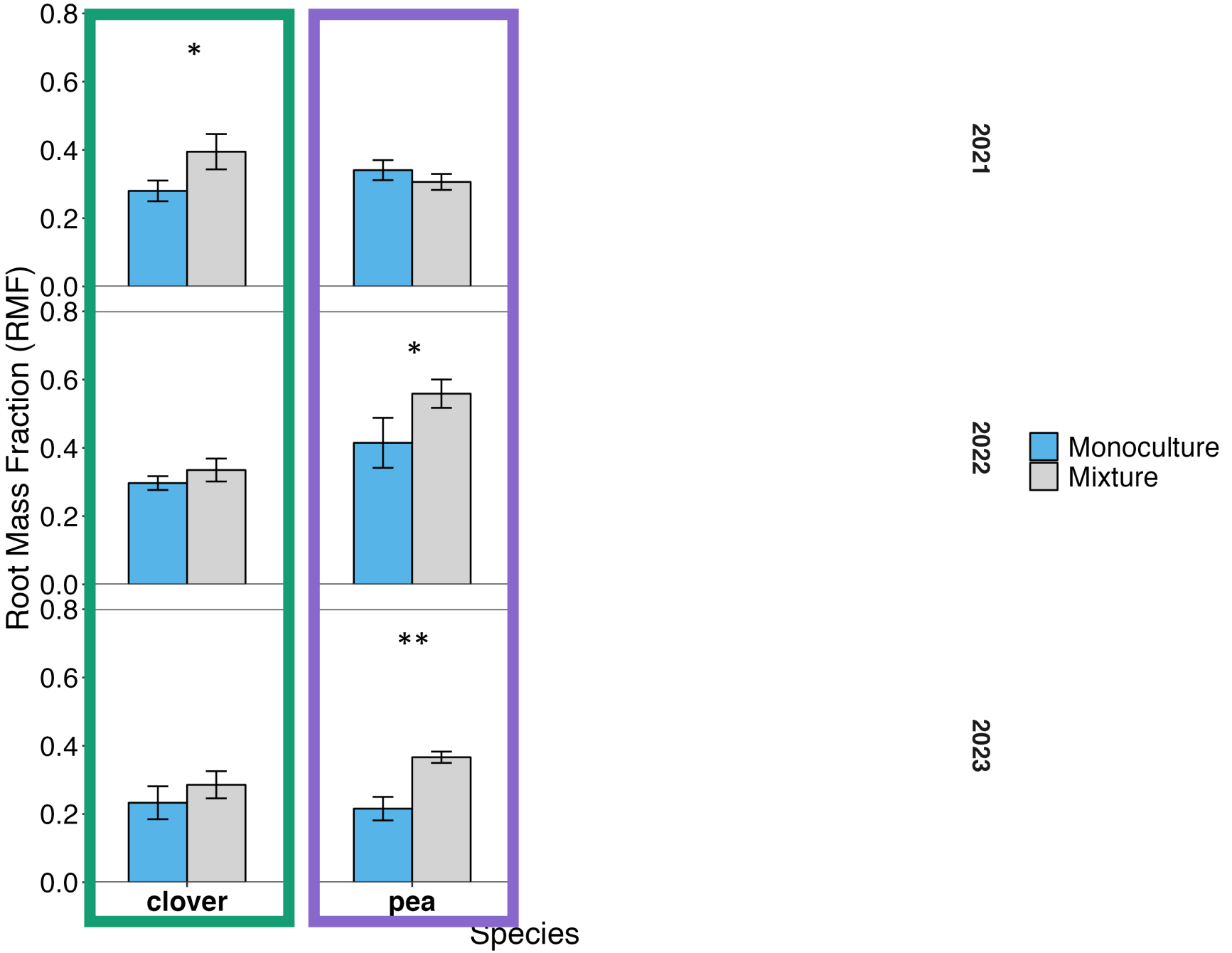

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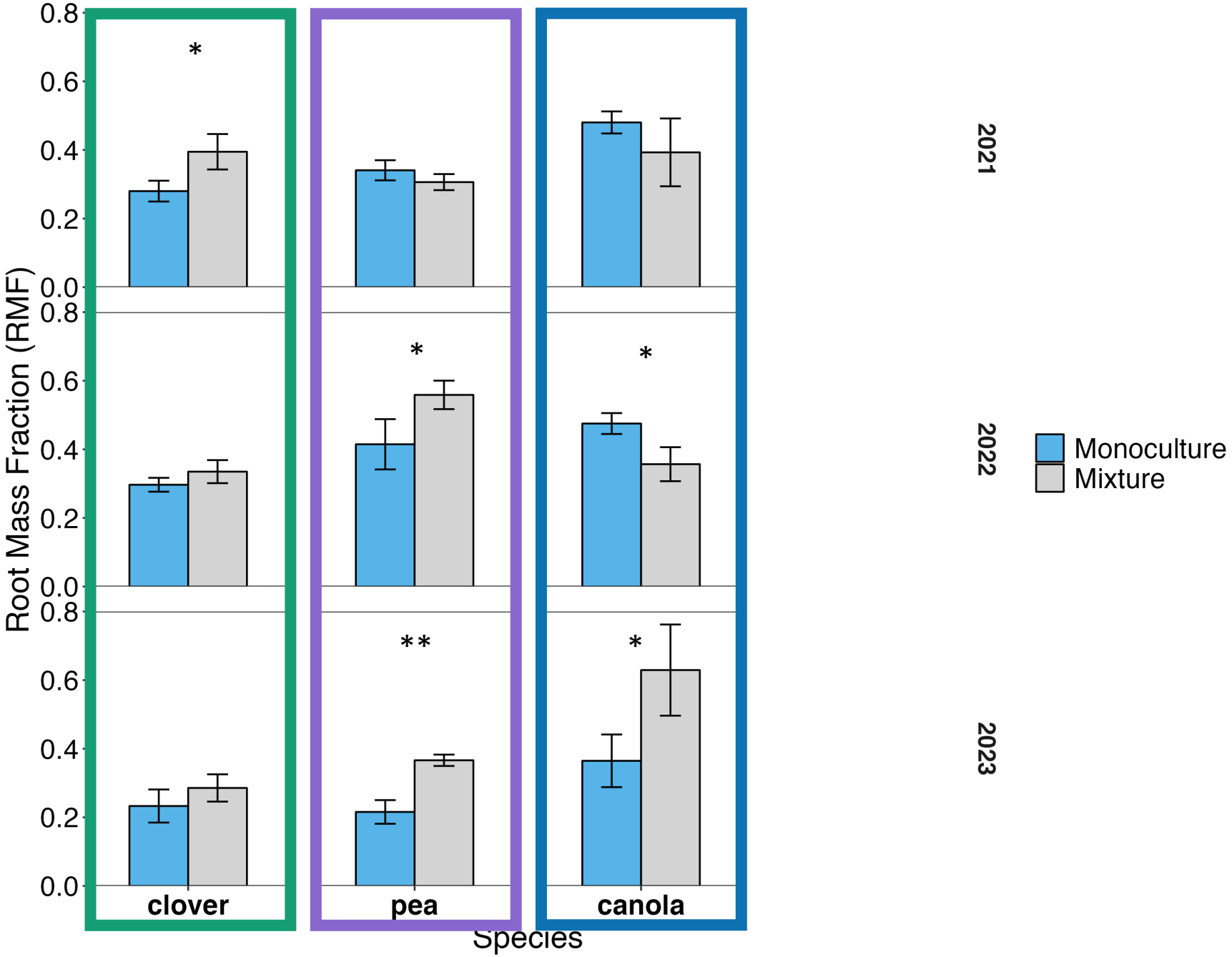

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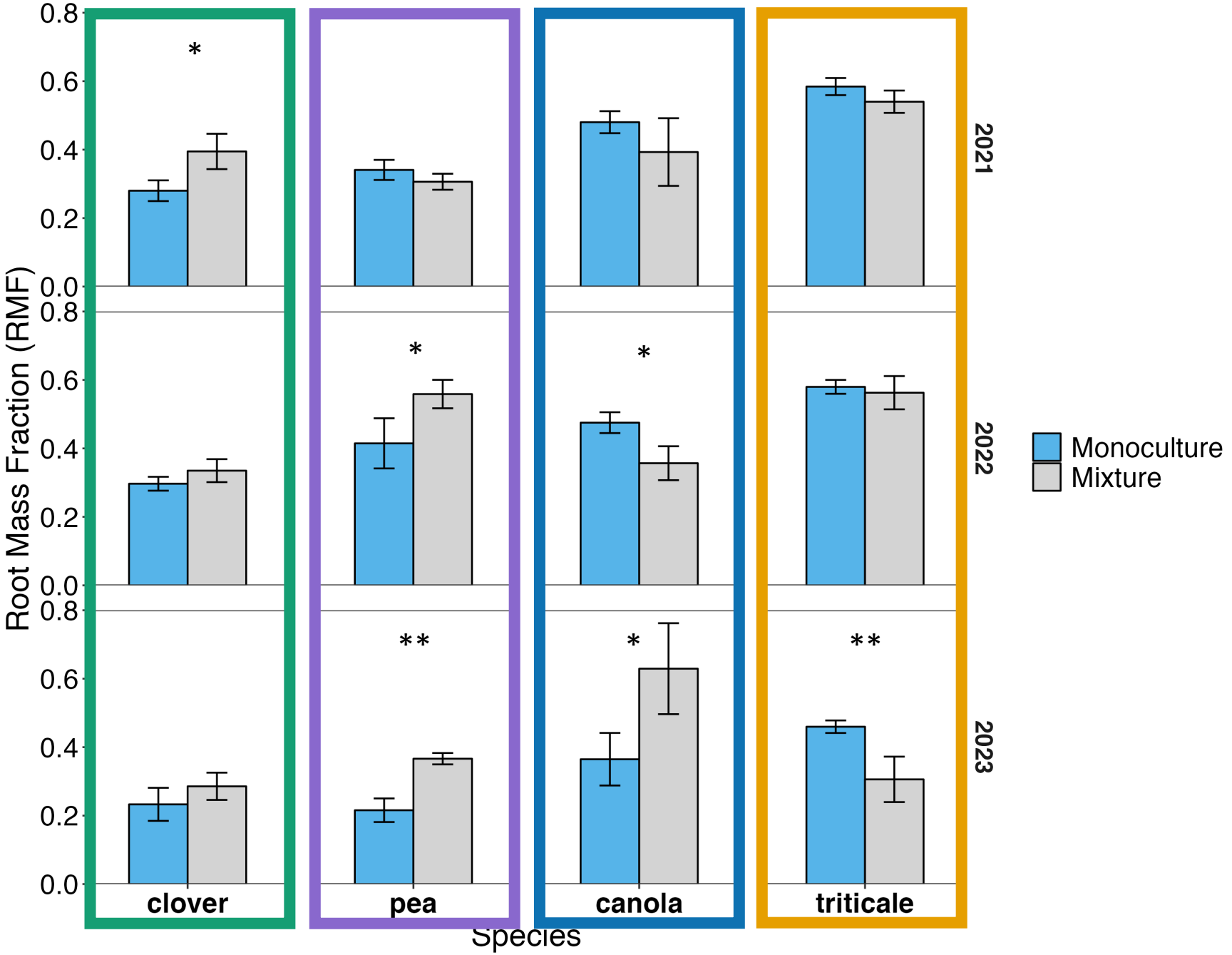


Preliminary Conclusions: Do species alter their biomass allocation between mixtures and monoculture treatments?

- Plants **alter their biomass** allocation in mixture compared to monoculture treatments.
- Species **response to treatment is variable** across years.
- Improve **mixture design** for optimized ecosystem service outcomes.

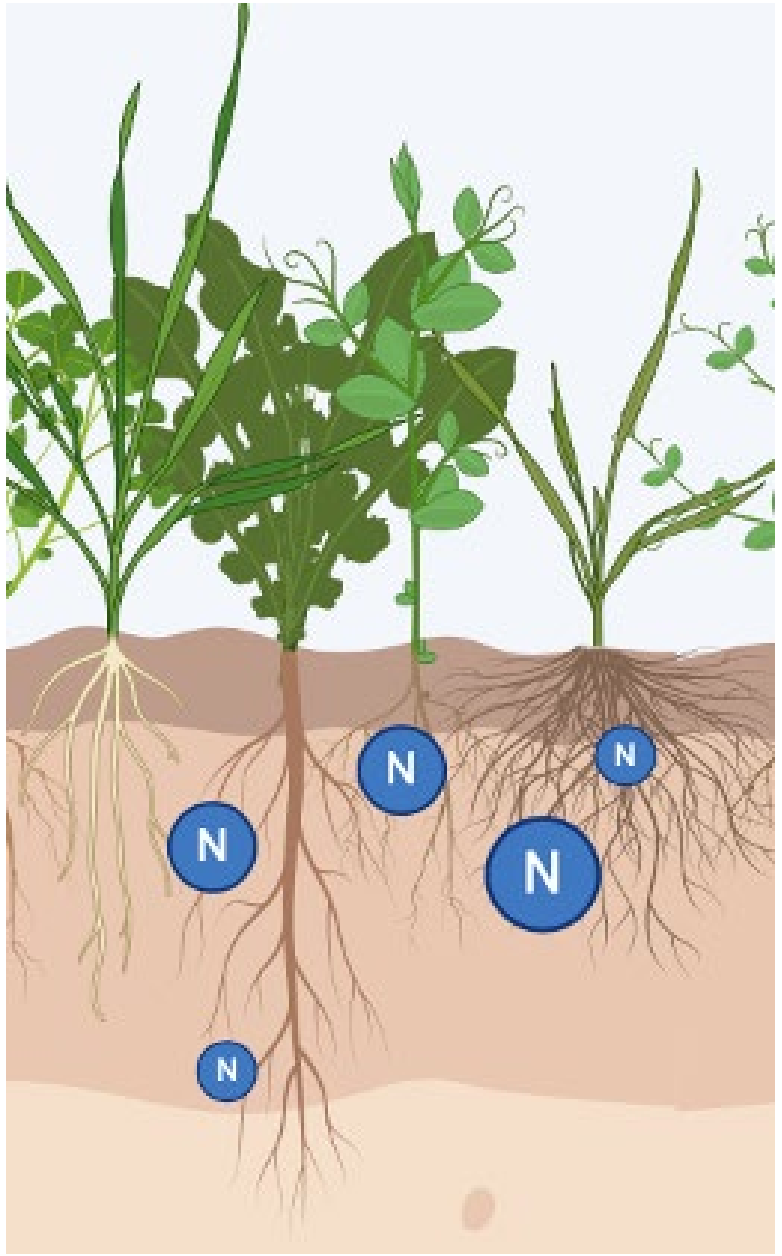
Research Questions

1. How do species alter their biomass allocation between mixtures and monoculture treatments?

2. Does including cover crop mixture root composition improve nitrogen leaching predictions?

Soil Nitrogen Retention

- Nitrogen retention in soils is linked to root functions.
- Typically shoot proportion used to predict N retention.
- Cover crops take up residual N in soils.

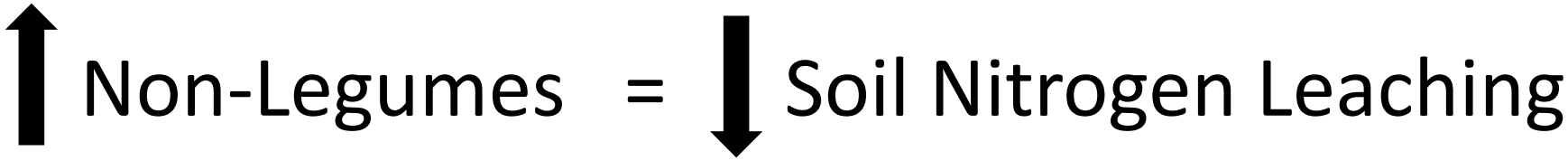


Nitrogen retention differs among cover crops

Good N retention
= reduce N leaching

Less effective N retention
= higher N leaching

Soil Nitrogen Retention : Why do we care?



Expect **shoot** data to be a *weaker* predictor than **root** data

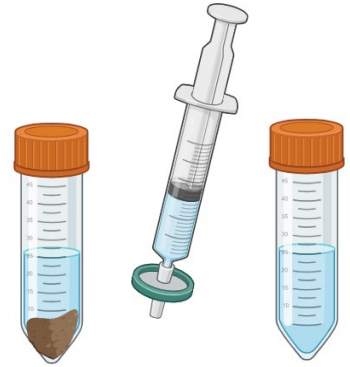
Predict the potential for nitrogen leaching by the quantity of inorganic nitrogen at deeper soil depths

Terminate cover crop

Deep rooting zone
(20-40cm)

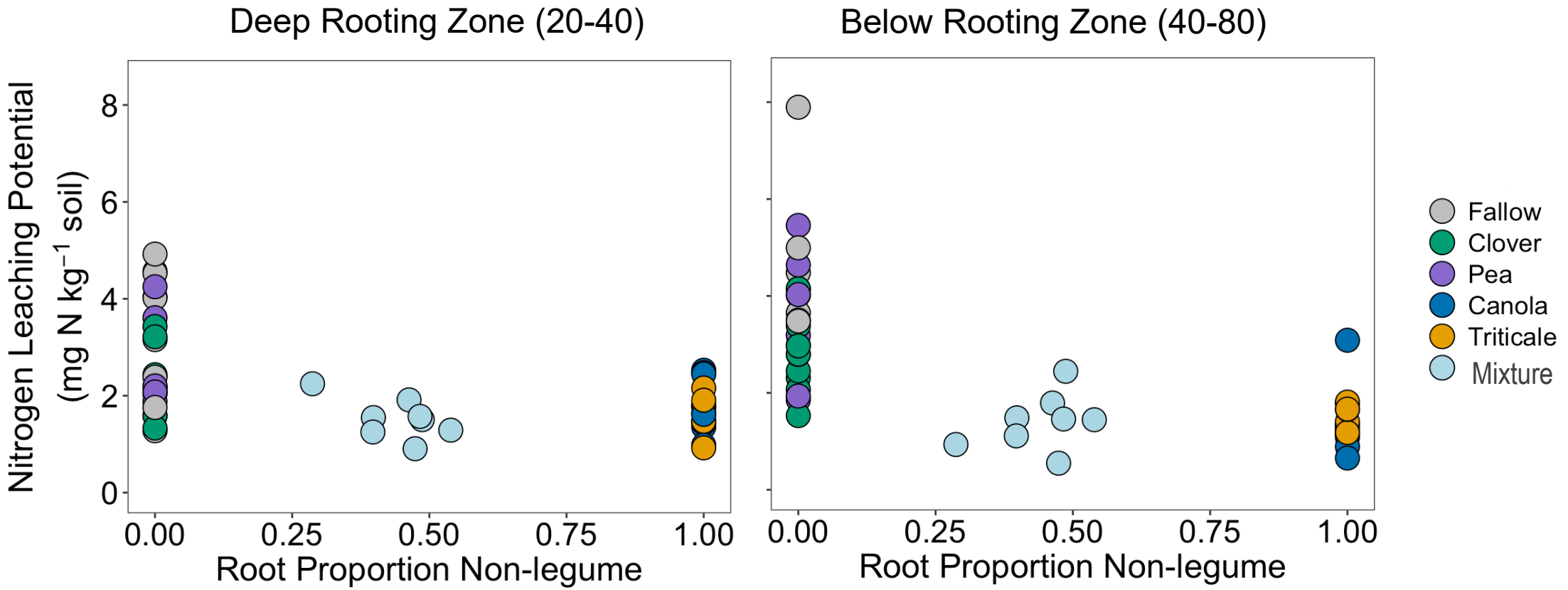
Below rooting zone
(40-80cm)

Collect soil and homogenize
by segment



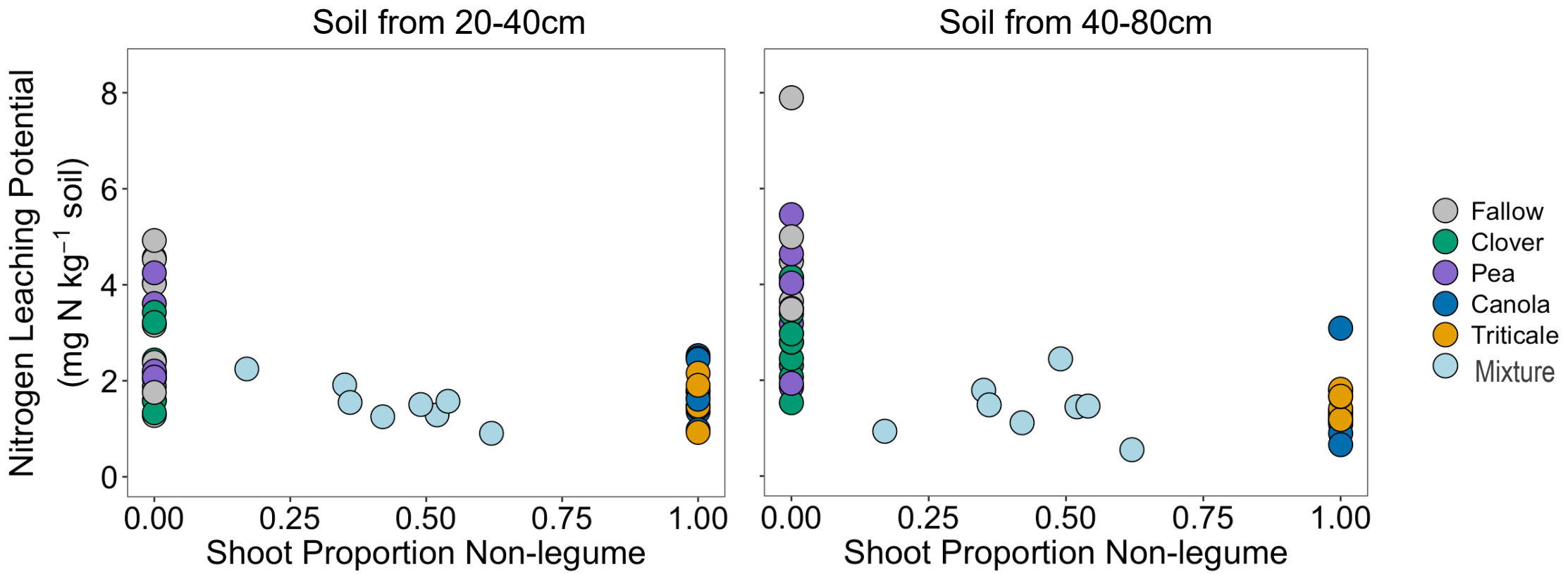
Extract inorganic N

Preliminary Results: As non-legume root proportion increases, nitrogen leaching potential decreases across depths



Mixtures were as effective as non-legume monocultures at reducing nitrogen leaching potential.

What about the shoots?

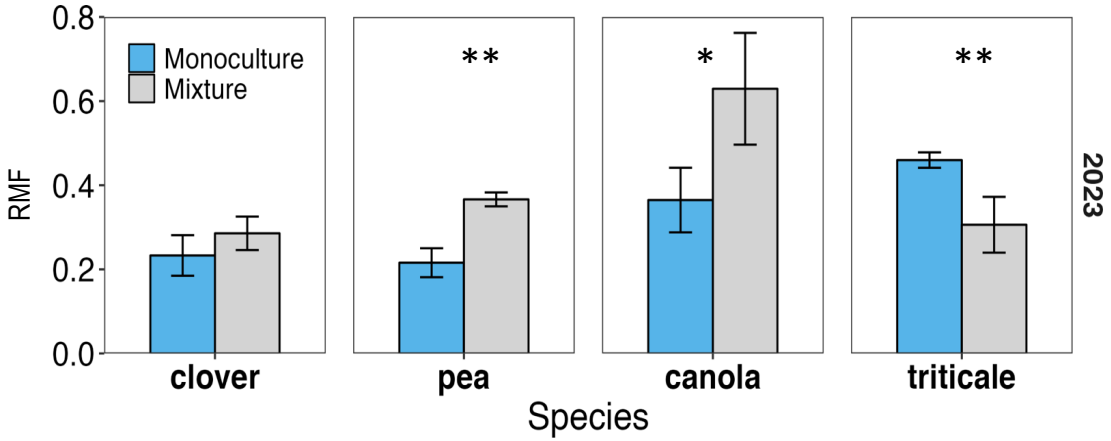


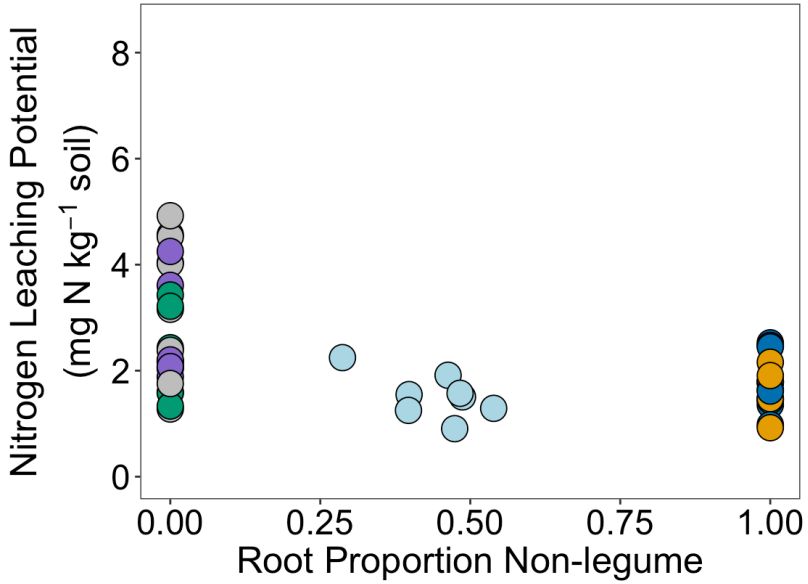
Non-legume **shoot** proportion is an <u>equally</u> good predictor across depths

Take Aways

- Cover crop species change their biomass allocation patterns in mixture.

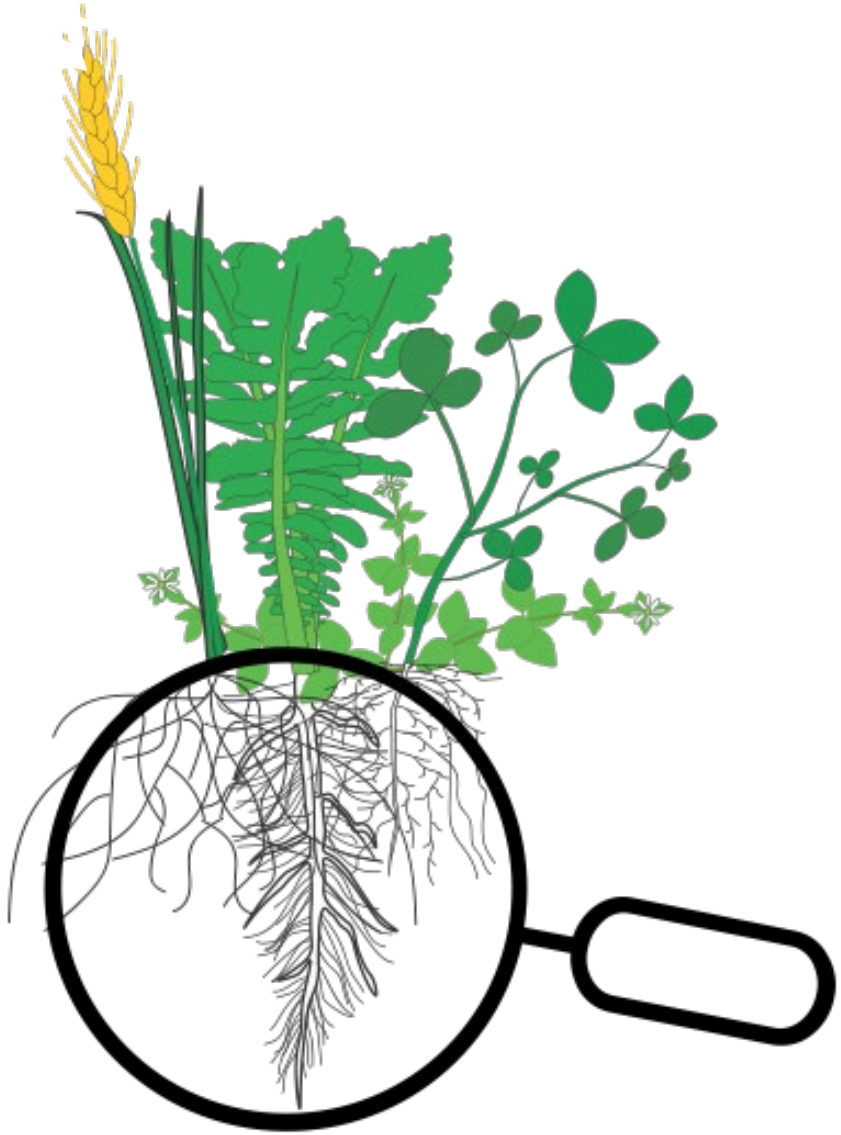
- Shoot species composition can predict soil nitrogen leaching potential as well as root composition.





Future Work

- Examine **spring root abundance and proportion** and ecosystem service provisioning
- Investigate **other root linked ecosystem services**
- Include **abiotic variables** in analysis



Thank you!

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