

Links between soil organic carbon and extracellular enzymes in topsoil but not in subsoil:

Evidence from long-term annual and perennial cropping systems

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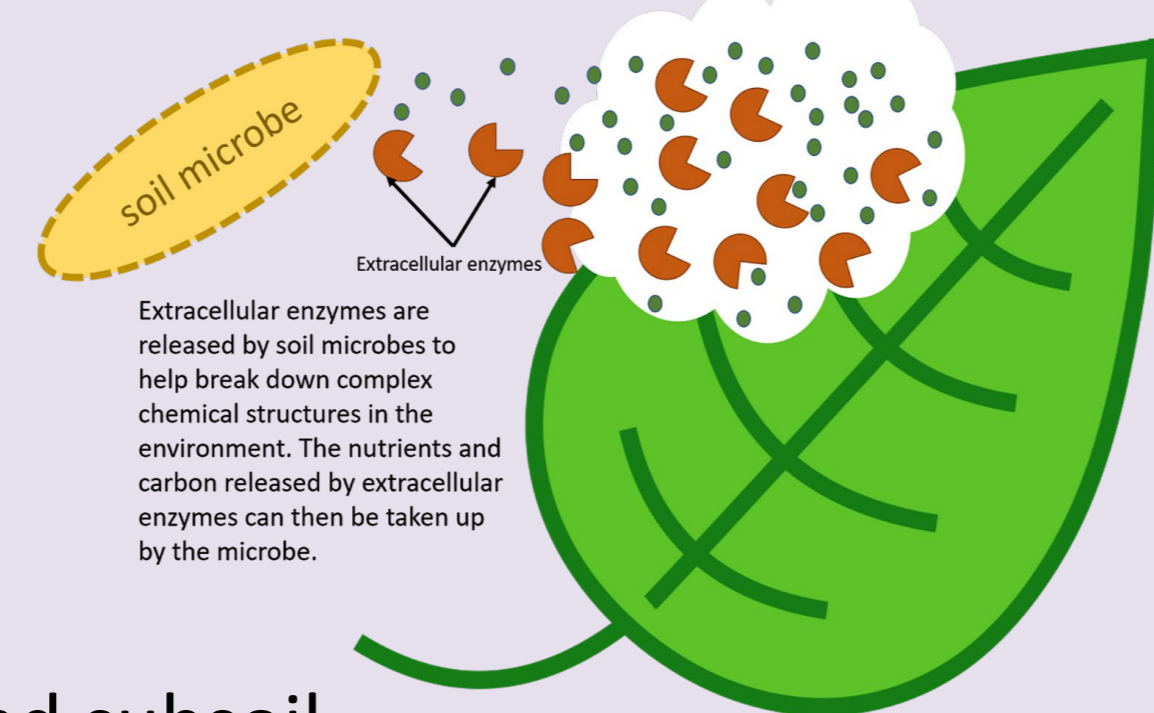
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Background and objectives

Perennial crops can be a sustainable alternative to annual crops owing to plant traits and management practices that improve productivity¹ and may contribute to soil carbon (C) accumulation². However, our understanding of soil C stock dynamics among perennial annual crops at different depths remains inadequate, not at least in relation to possible differential roles of soil extracellular enzymes and their controls³.

O1: Evaluate if soil C stocks were modified in the topsoil and subsoil by growing either annual or perennial crops

O2: Understand the mechanisms driving these potential effects in the topsoil and subsoil



Sampling and analysis



Plant properties:

- Root biomass
- C/N ratio in aboveground biomass
- Growing cycle

Soil properties:

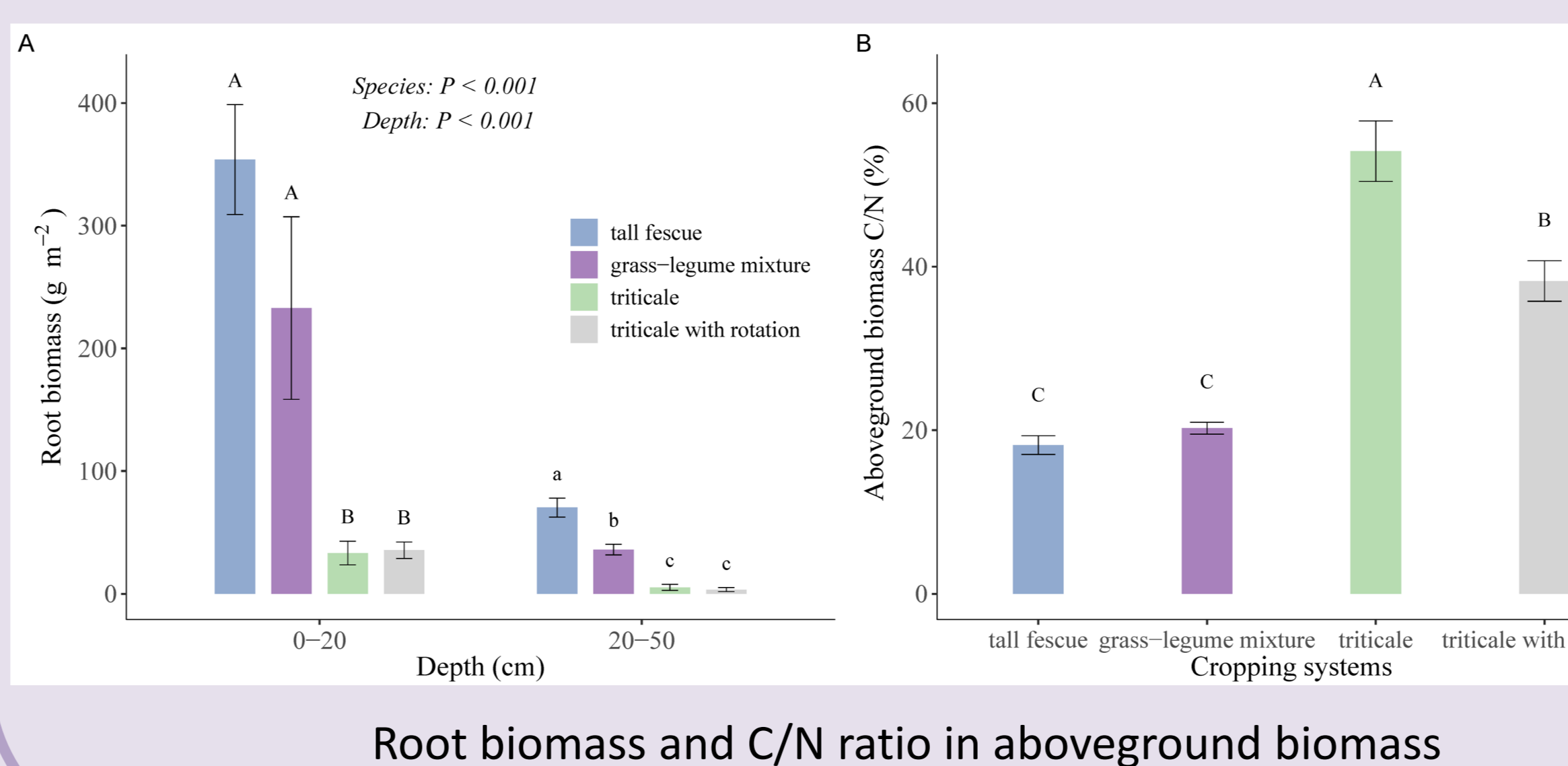
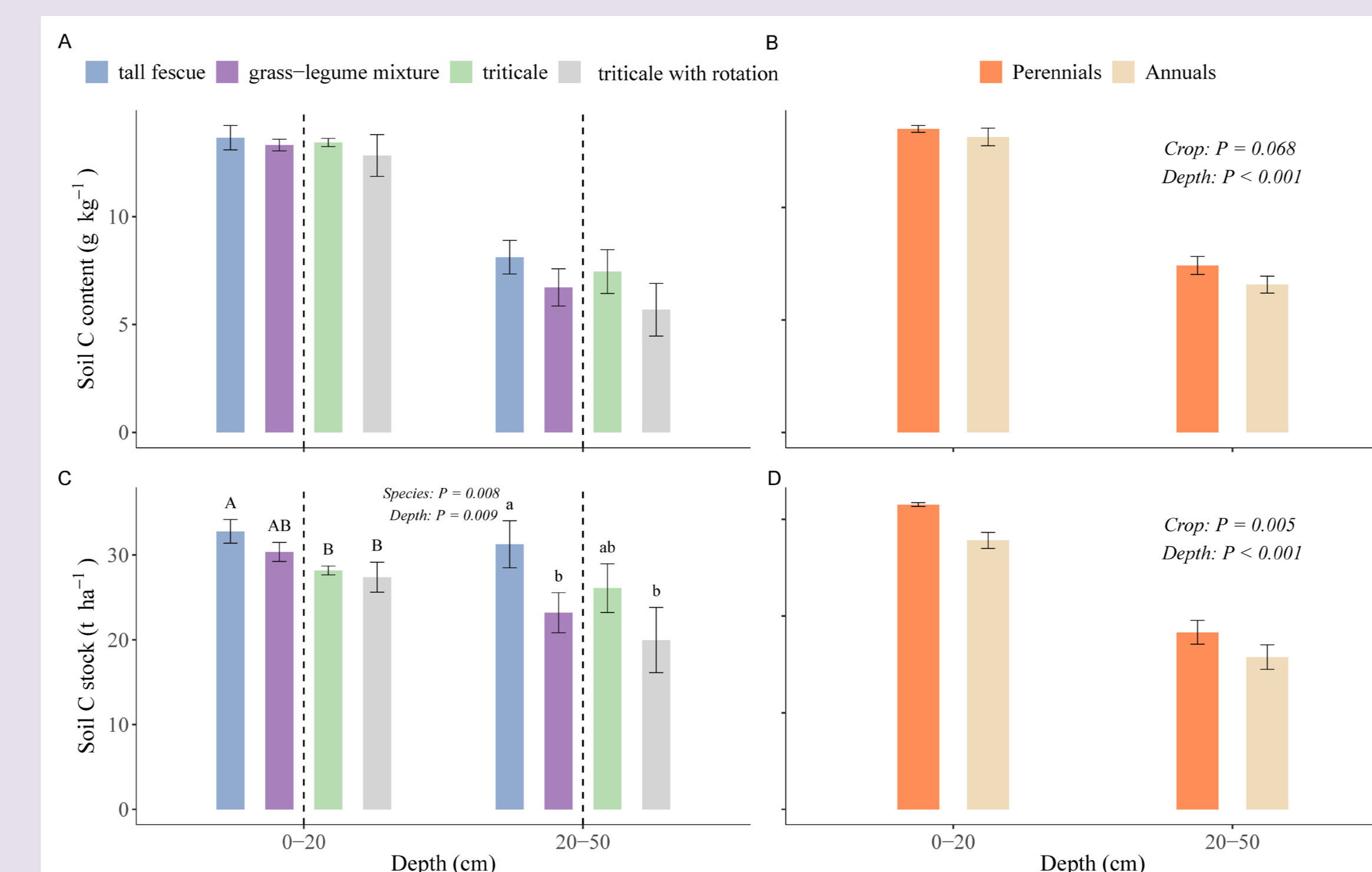
BD; pH; SWC; N; P; OlsenP; NH₄⁺; NO₃⁻

Microbial properties:

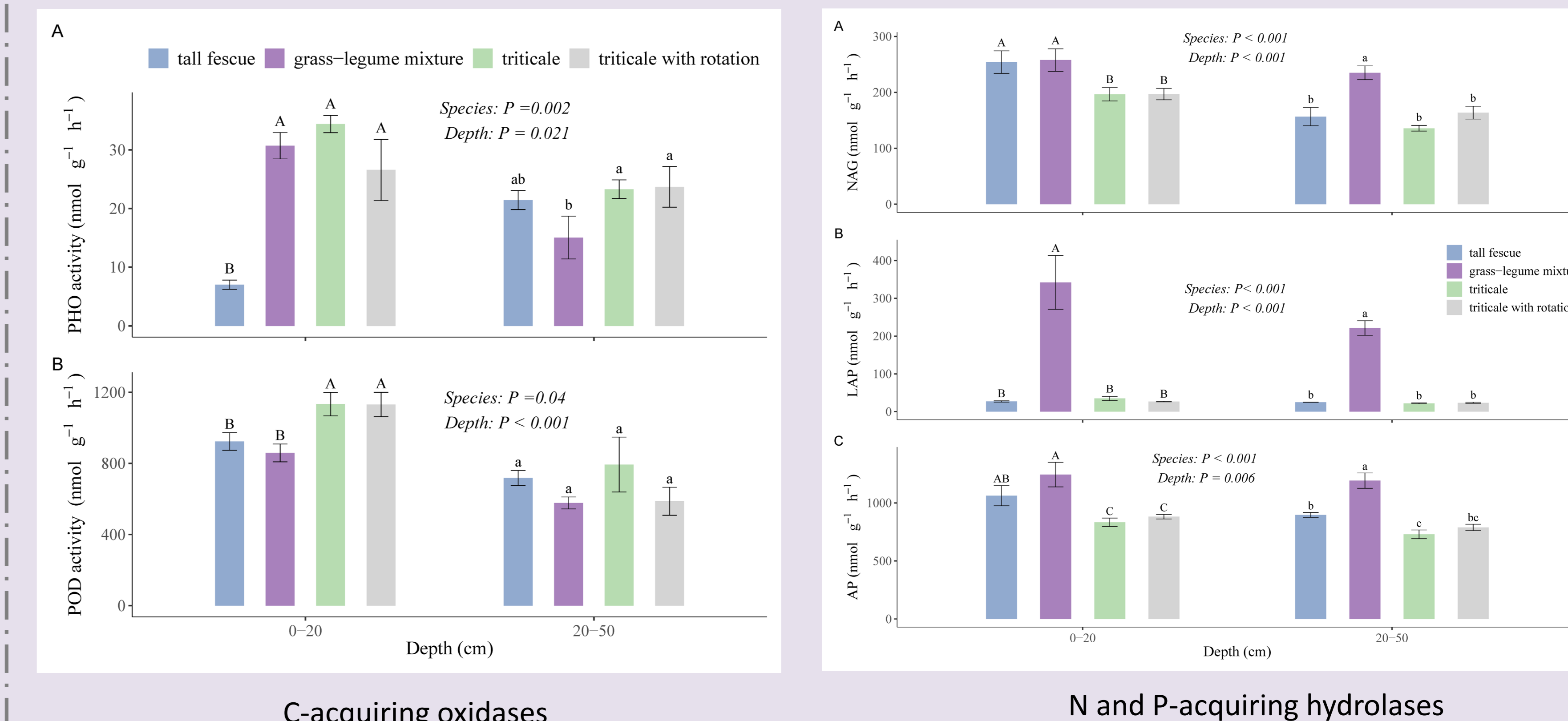
- Microbial biomass C, N and P
- C-acquiring enzymes (α-1,4-glucosidase; β-1,4-glucosidase; cellobiohydrolase; phenol oxidase; peroxidase)
- N-acquiring enzymes (leucine amino peptidase; β-1,4-N-acetylglucosaminidase)
- P-acquiring enzymes (acid phosphatase)

Results

Cropping systems and depths effects on the soil C content and soil C stock



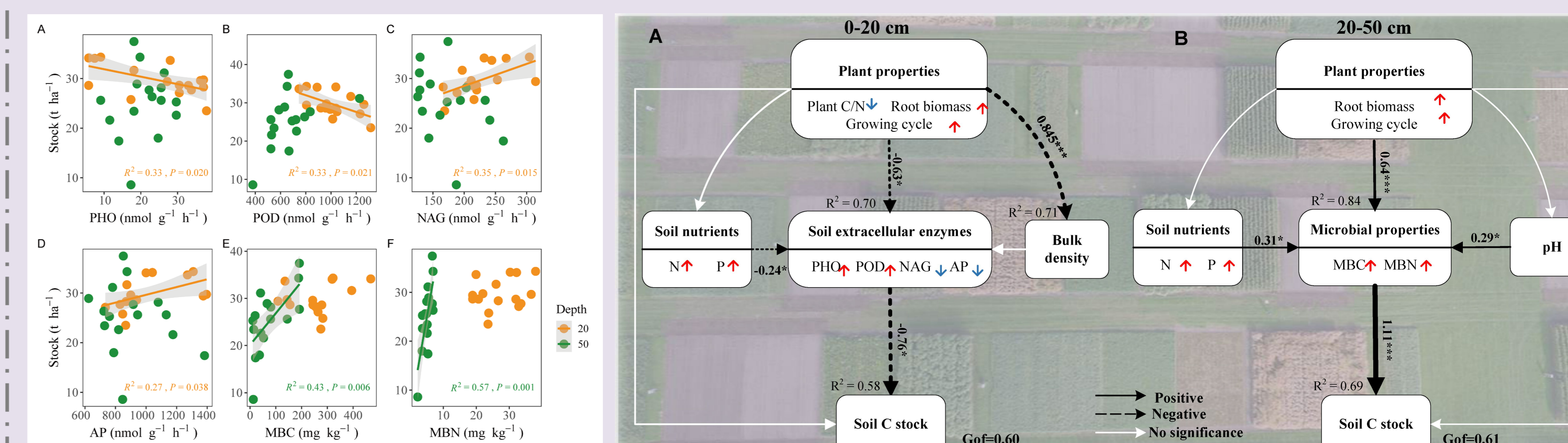
Cropping systems and depths effects on biotic factors



C-acquiring oxidases

N and P-acquiring hydrolases

Depth-dependent determinants of the effects of different cropping systems on soil C stock



Relationships between C stock and biotic factors

The direct and indirect effects of multiple drivers on the soil C stock

Conclusions

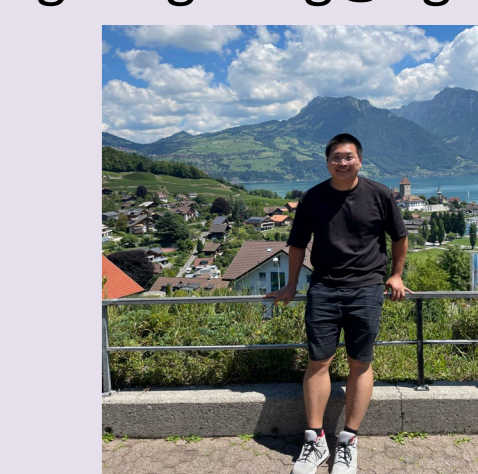
- ✓ Perennial crops can promote soil C stock compared to annuals, but the effect on the soil C stock varies according to soil depth, and depends on the specific perennial crop.
- ✓ In the topsoil, the perennials with low C/N ratio in aboveground biomass and high root biomass were linked to lower activities of oxidases and higher levels of N and P-acquiring enzymes.
- ✓ In the subsoil, perennials with high root biomass enhanced C stock by promoting microbial biomass.

Acknowledgements

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