Wild solutions: unlocking the potential of native grass microbiomes to boost crop resilience to environmental stress

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Introduction

- Plants interact with diverse soil microbes at the root interface, influencing nutrient cycling, stress resilience, and natural pest regulation[1]. Yet, human activities have **degraded over 60% of European soils**[2].
- Native grasses thrive across contrasting soil, climatic, and disturbance regimes and exhibit distinct ecological strategies, namely **Competitors, Stress-tolerators, and Ruderals** (disturbance-adapted), under the **CSR life-history strategy framework** [3].
- We hypothesise that the **ecological strategy of plants is driven in part by associated rhizosphere microbes**, recruited by the plant, which confer adaptive functions.
- By targeting grasses with contrasting strategies, we will create a **structured and ecologically informed framework** for understanding and harnessing the benefits of stress-adapted microbes.

Research objectives

Characterise native grasses' rhizosphere microbiome across watering regimes

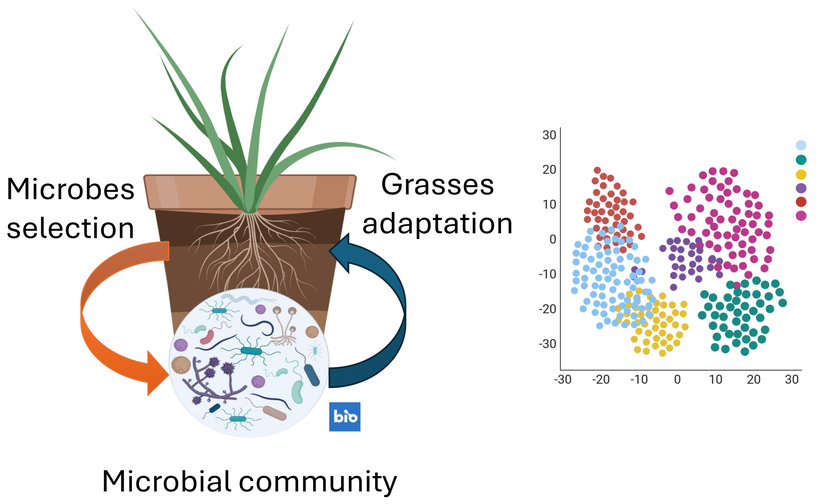


Figure 1. Conceptual model of grass–rhizosphere microbiome interactions (left) and microbial community ordination (right).

Build a culture library of beneficial microorganisms

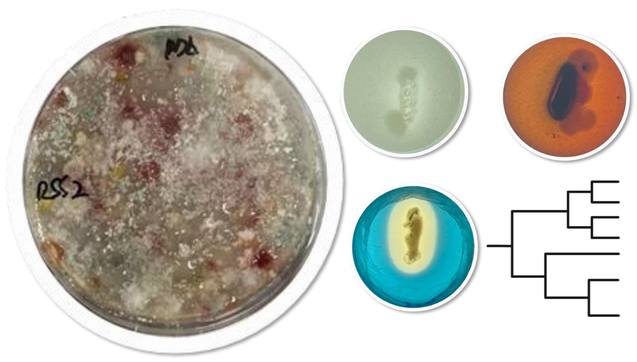


Figure 2. Culture-based isolation and characterisation of microorganisms, including phenotypic screening and phylogenetic analysis.

Test microbial inoculants for crop stress tolerance and pest resistance

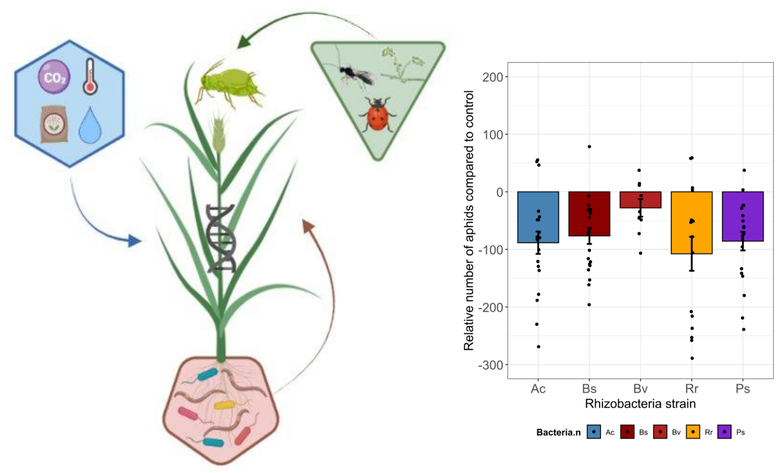


Figure 3. Conceptual model of plant–microbe–insect interactions (left) and effects of bacterial inoculation on aphid abundance (right).

Current progress

Grass species selection and soil inoculum

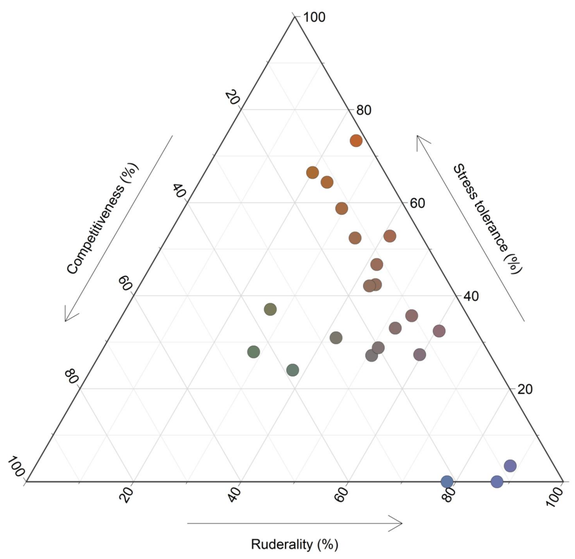


Figure 4. CSR strategy scores (%) of the 22 selected grass species [4, 5].

Soil inoculum sources

S-associated: Low-nutrient, alkaline grassland
R-associated: Disturbed grassland
C-associated: Fertile, stable grassland

Substrate: John Innes No. 1 compost + perlite
Mixed inoculum: 5% (v/v) from each soil source (15% total)

Purpose of soil inoculum: To provide the grasses with a diverse microbial pool for rhizosphere community assembly.

Pot experiment at Ness Botanic Gardens (June – Oct 2026)



Experimental design and conditions

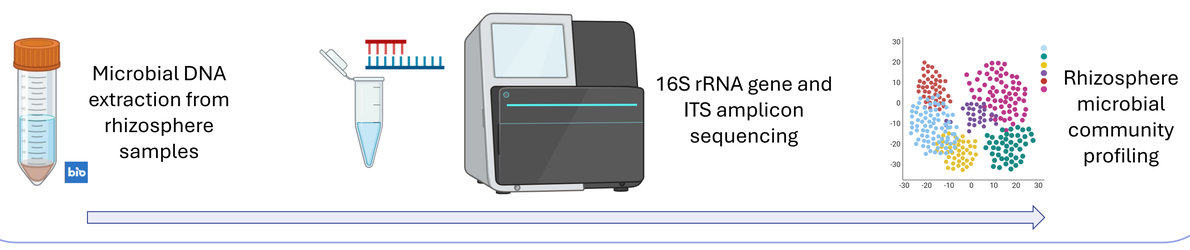
RCB with split-plot design
22 grass species
Well-watered and drought
Drought at 10-15% VWC

Plant trait measurements

Aboveground dry biomass
Longest leaf length
Canopy height
Chlorophyll index

Next steps and research questions

Rhizosphere soil collected for downstream analysis



Research questions guiding downstream analysis

Q1: Do grasses with similar CSR strategies harbour similar rhizosphere microbiomes?
Q2: Do grasses with similar CSR strategies exhibit similar microbiome responses to drought?
Q3: Which microbial taxa are enriched in grasses that maintained growth under drought treatment, regardless of CSR strategy?

Intended outcome

This project will characterise the rhizosphere microbial communities associated with plants of different CSR strategies, focussing on the differences in each community's function and structure. This will allow for a systematic and targeted approach of microbial isolation to identify microbes with desirable functional traits. The outcomes will inform strategies for harnessing root microbiomes as a cornerstone of regenerative agriculture and climate-resilient food systems.

References

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