Introducing the UK Crop Microbiome Cryobank with a case study in sugar beet

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1. Objective

To establish a cryopreserved and characterised crop microbiome resource to underpin UK and international crop research. The focus is on the microbiomes of major UK crops from 3 soil types from multiple geographical locations across the UK.

2. Aim

Develop a resource to provide a facility for researchers to source genomic sequence and phenotypic data and samples (including living microbial material) from the rhizosphere and bulk soil of multiple crop plants in multiple soil types.

3. Partners

CABI, SRUC, Rothamsted Research, John Innes Centre – Unlocking Nature's Diversity, The James Hutton Institute

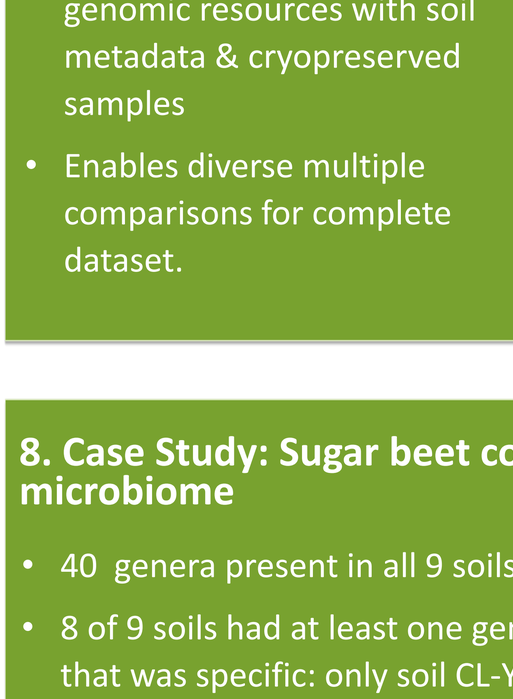

Fig 4: Via Freeze™ Duo Stirling cycle cooler

4. Project Overview

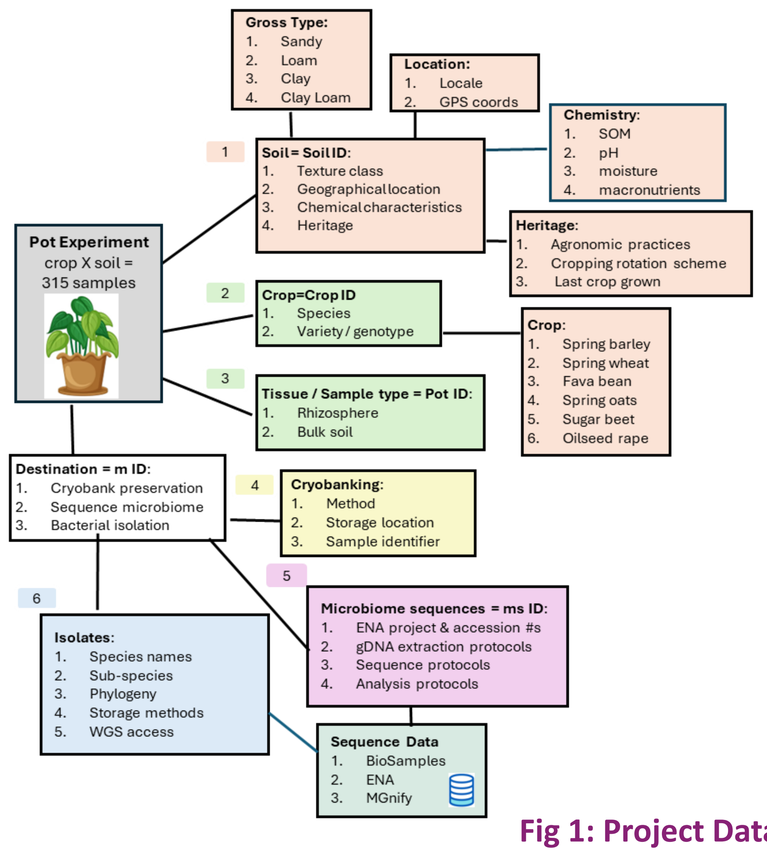

Fig 1: Project Data

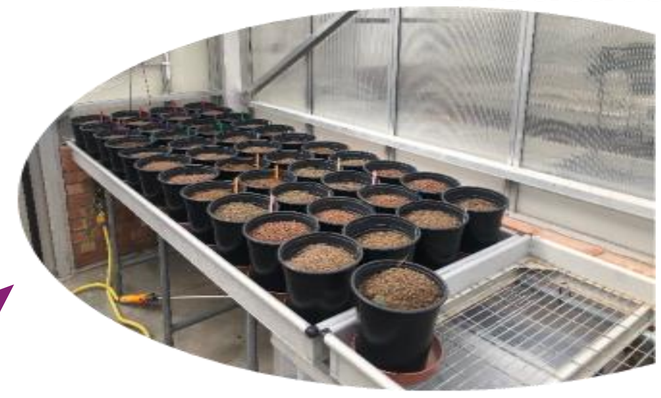

Fig 2. Large scale pot experiment

5. Biological Samples

Common Name (Project Code)	Species name
Fava Beans (FB)	*Vicia faba*
Oilseed Rape (OR)	*Brassica napus*
Spring Barley (SB)	*Hordeum vulgare*
Spring Oats (SO)	*Avena sativa*
Spring Wheat (SW)	*Triticum aestivum*
Sugar Beet (SU)	*Beta vulgaris*

Table 1: Five crops

Textural Class	UK County	Project Code
Clay loam	Borders	CL-BO
Clay loam	Yorkshire	CL-YO
Clay	Buckinghamshire	CY-BU
Clay	Yorkshire	CY-YO
Silty clay loam	Shropshire	SC-SH
Sandy loam	Angus	SL-AN
Sandy loam	Bedfordshire	SL-BE
Sandy loam	Shropshire	SL-SH
Silty clay loam	Hertfordshire	SC-HE

Table 2: Nine agricultural soils

6. Methods

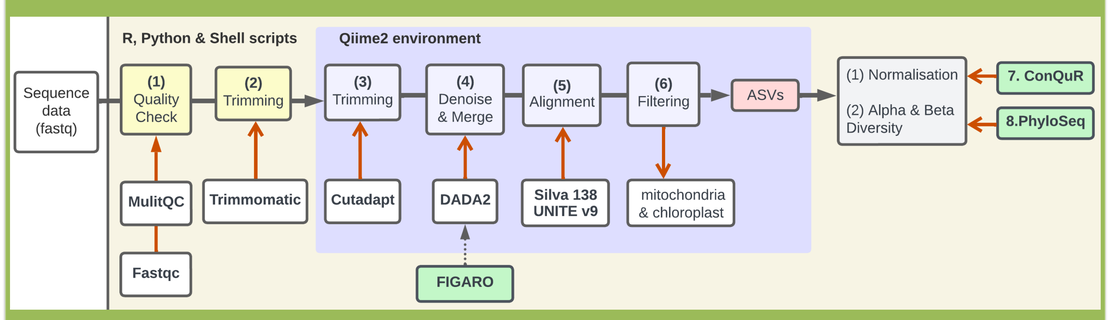

Fig 3: Workflow for analysis of 16S and ITS amplicon sequence data

7. Results

- https://agmicrobiomebase.org **P**ublic catalogue linking genomic resources with soil metadata & cryopreserved samples
- Enables diverse multiple comparisons for complete dataset.

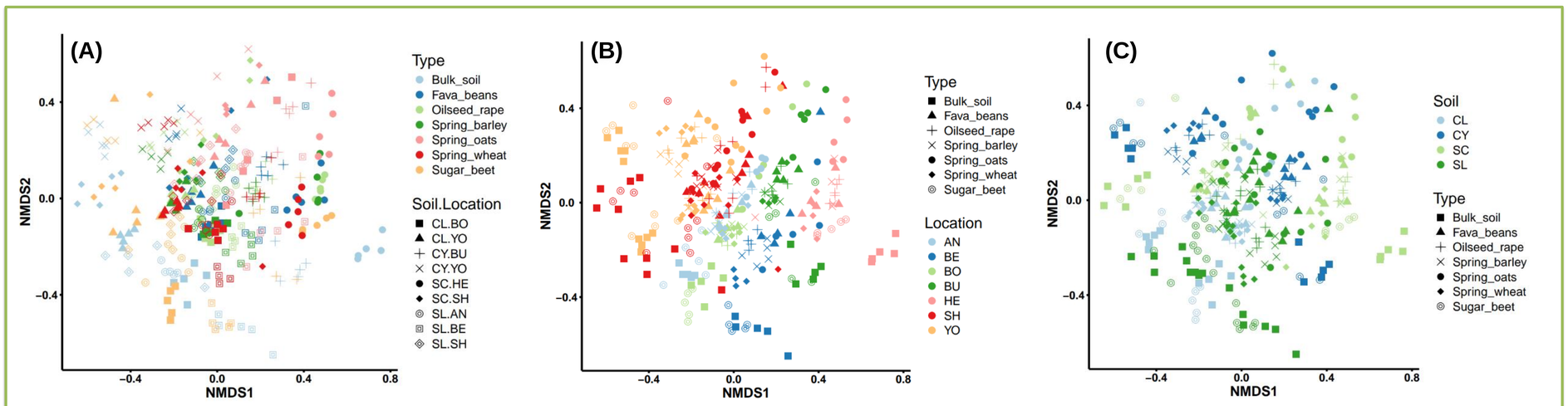

Fig 5: Location driven microbe recruitment. NMDS ordination plots of beta diversity (Bray-Curtis) for the complete dataset (A) Colours based on crop (B) Colours based on location (C) Colours based on soil type

8. Case Study: Sugar beet core microbiome

- 40 genera present in all 9 soils.
- 8 of 9 soils had at least one genus that was specific: only soil CL-YO did not have a unique genus.
- Clay (CY) was only soil type that contained common genera across different locations.

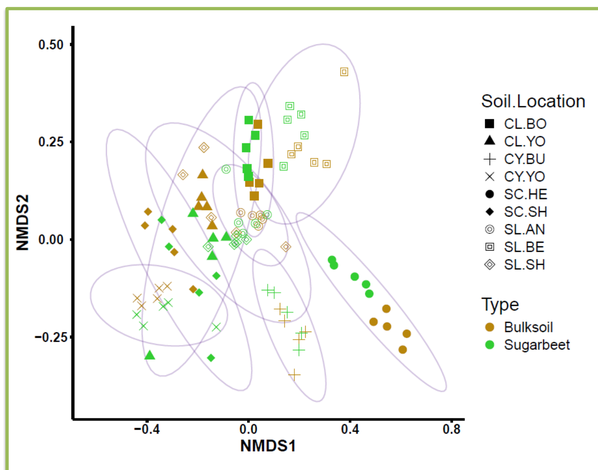

Fig 6: NMDS ordination plot of beta diversity for sugar beet rhizosphere and bulk soil.

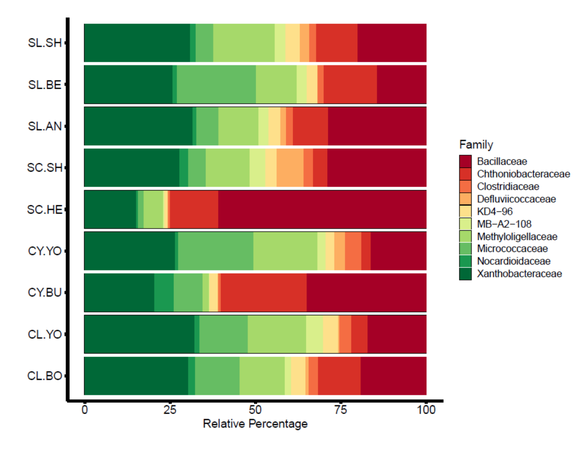

Fig 7: Relative percentage of ASVs assigned to top 10 taxonomic groups at the family level for the 9 soils

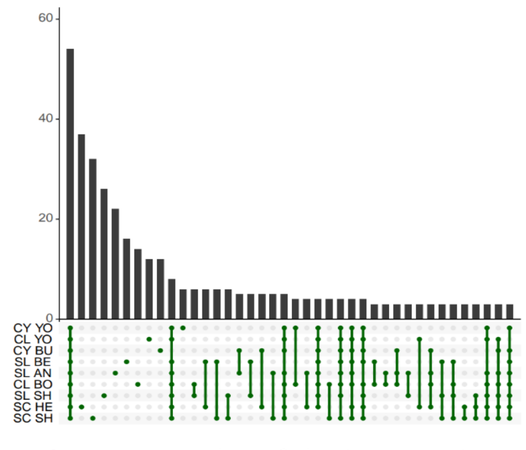

Fig 8: UpSet plot of the intersection of taxa sets for 100 most abundant ASVs assigned at genus level

Scottish Government / Riaghaltas na h-Alba / gov.scot

Reference

Ryan, et al. The UK Crop Microbiome Cryobank: a utility and model for supporting Phytobiomes research. CABI Agric Biosci 4, 53 (2023).

Acknowledgements

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UKRI Biotechnology and Biological Sciences Research Council