Controlling mIcRobiomes Circulations for Better food Systems

CIRCLES H2020: CAN NATURAL MICROBIOMES BE EXPLOITED FOR MORE SUSTAINABLE, PRODUCTIVE AND NUTRITIOUS FOOD PRODUCTION?

Phytobiomes Alliance: 5 November 2020

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 818290.

Outline

1 - Introduction
2 - Background and relevance
3 - What is CIRCLES?
4 - The role of our team in CIRCLES
5 - Preliminary findings
6 - COVID-19: Challenges and opportunities
7 - Summary

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Meet #TeamDB @TeamDB_Lab

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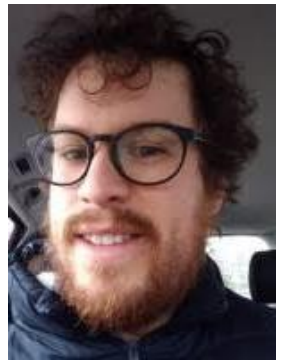

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Funding

European Commission | Horizon 2020 European Union funding for Research & Innovation

UKRI Biotechnology and Biological Sciences Research Council

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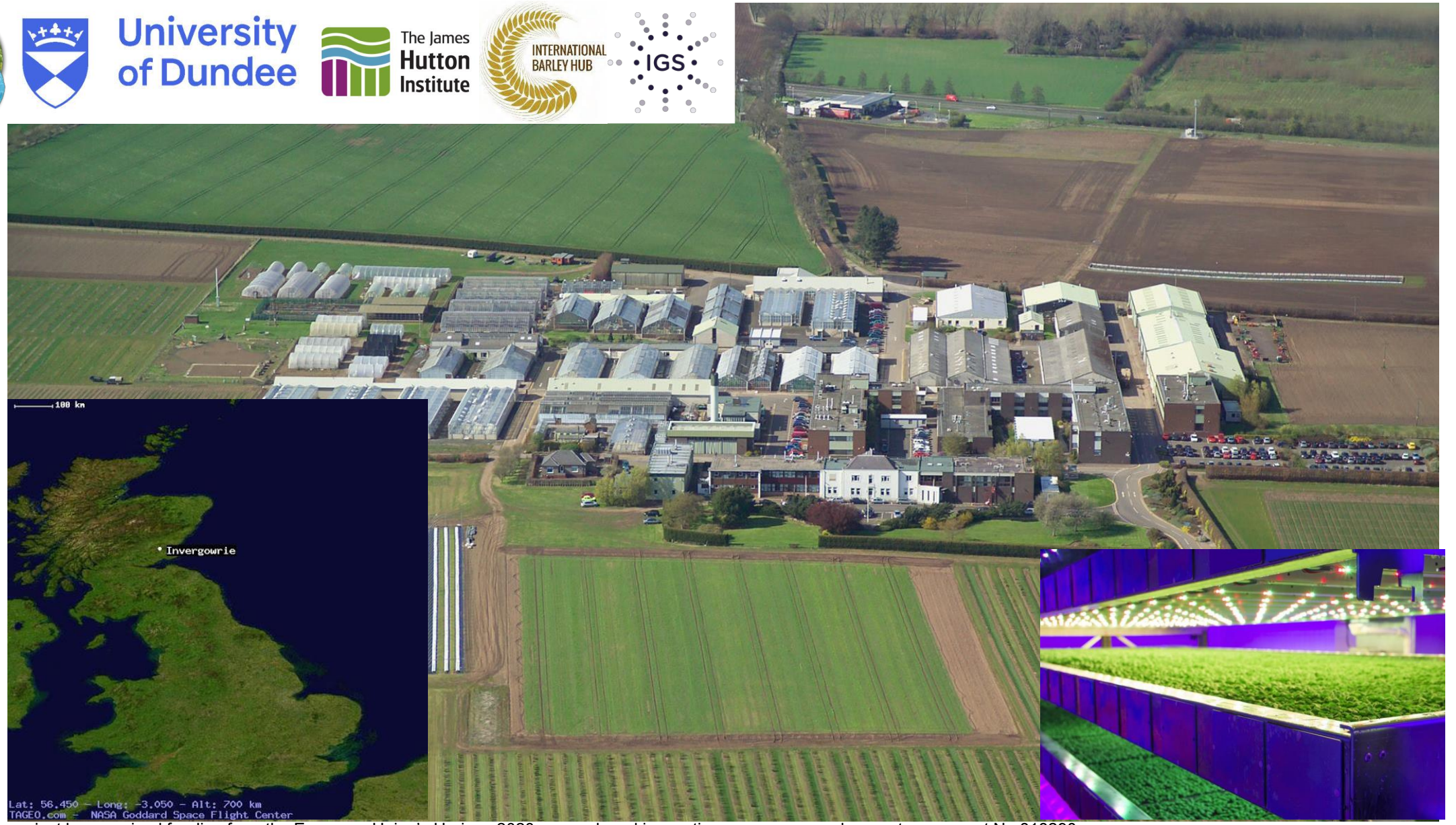
Where to find us



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Background

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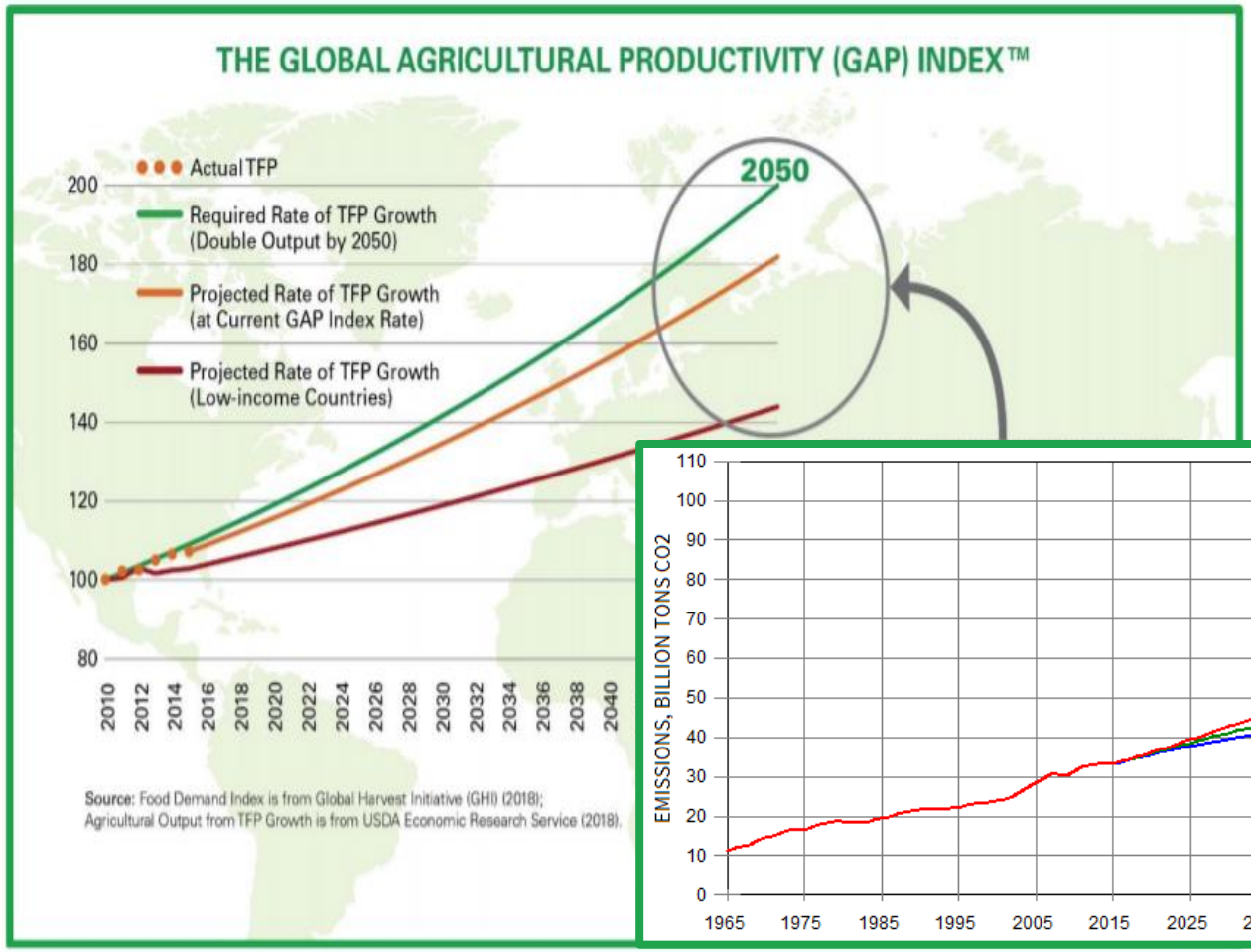
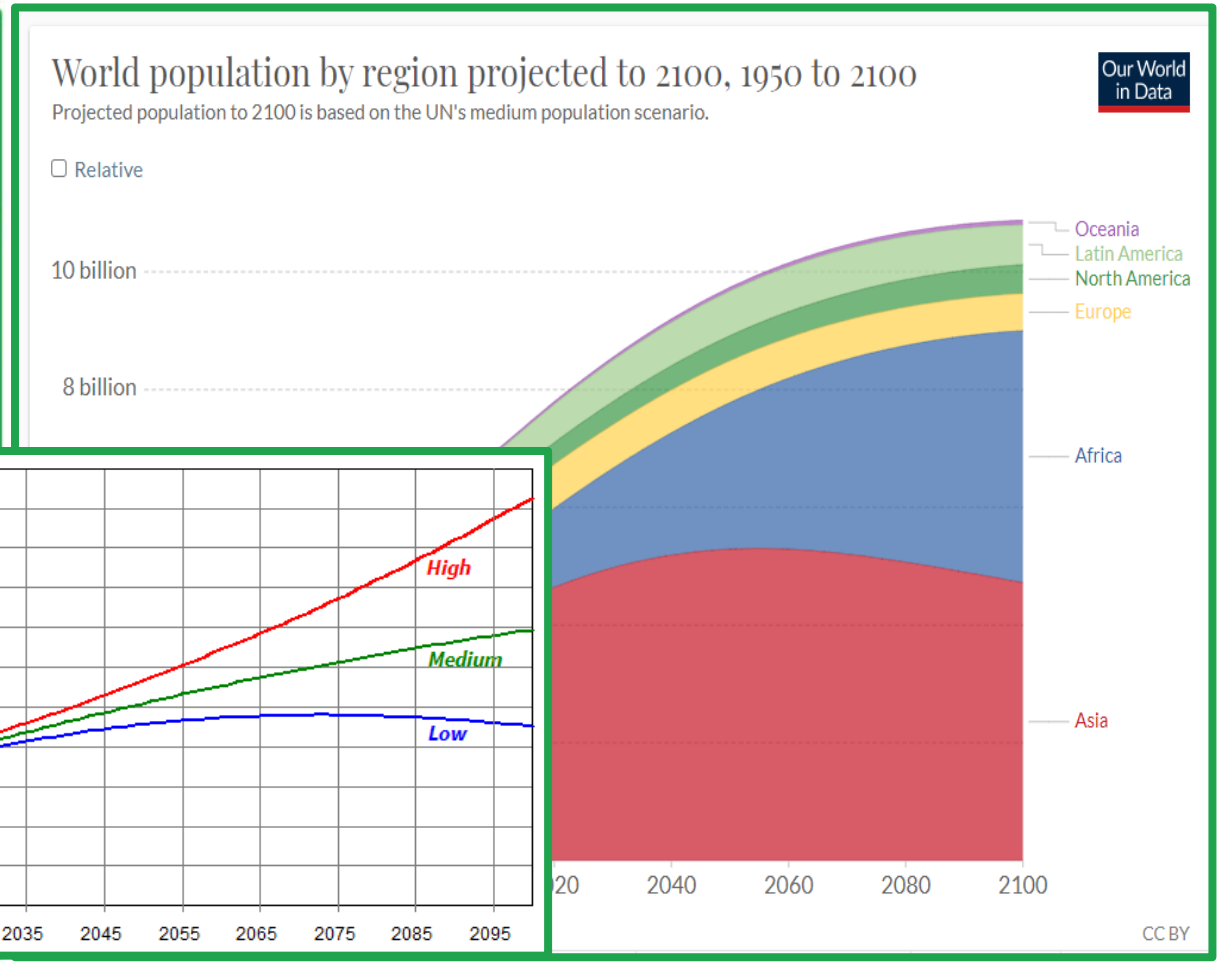
Global Challenges





Energy matters: Global energy forecast to 2100

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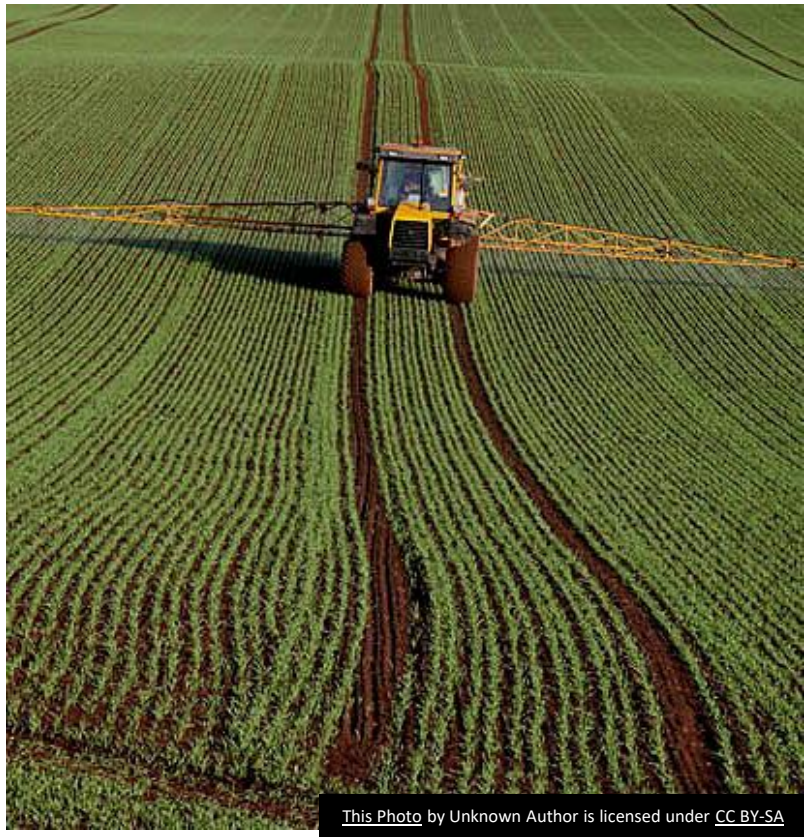
Impact and Urgency: The need for a sustainable approach



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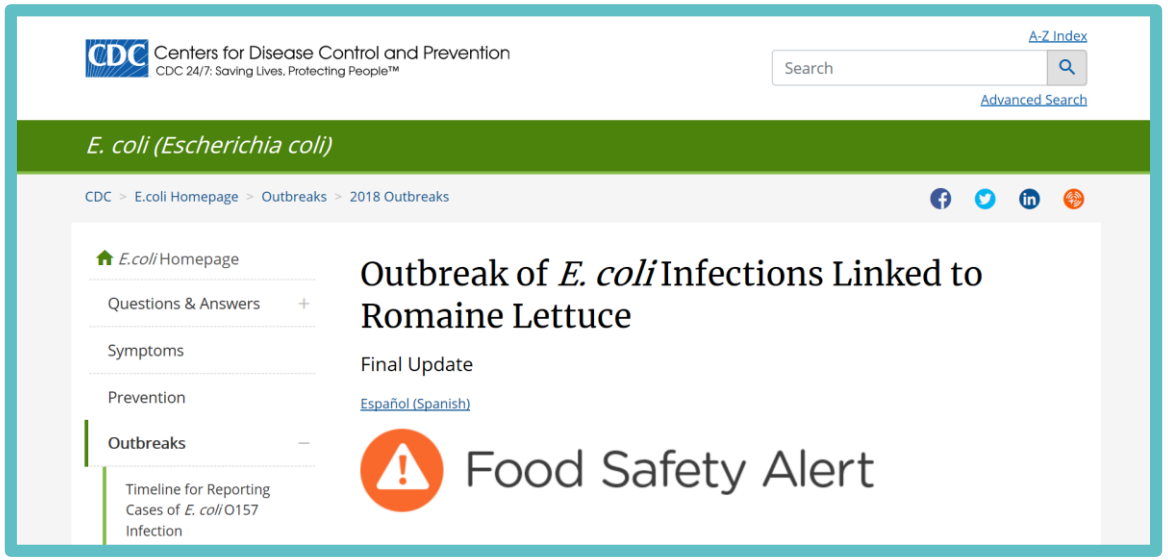
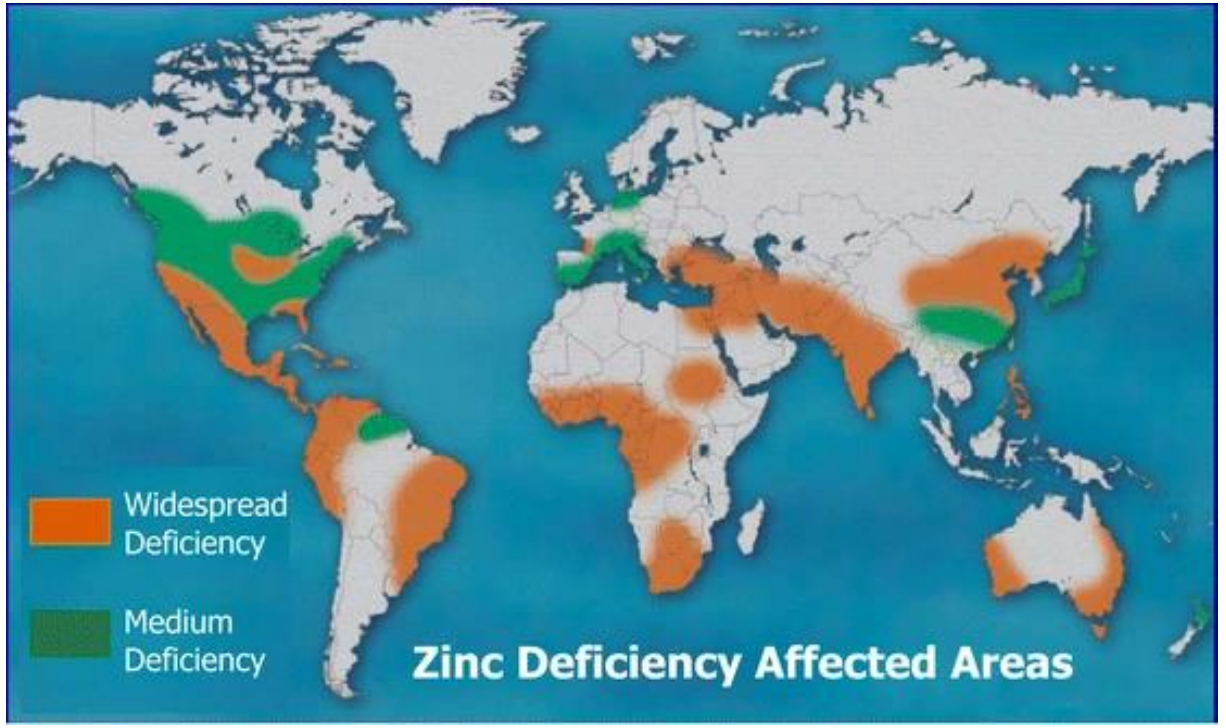
Plant health = Human health

Pathogenic internalization



Nutritional Content



Alloway. B.J, International Zinc Association 2004

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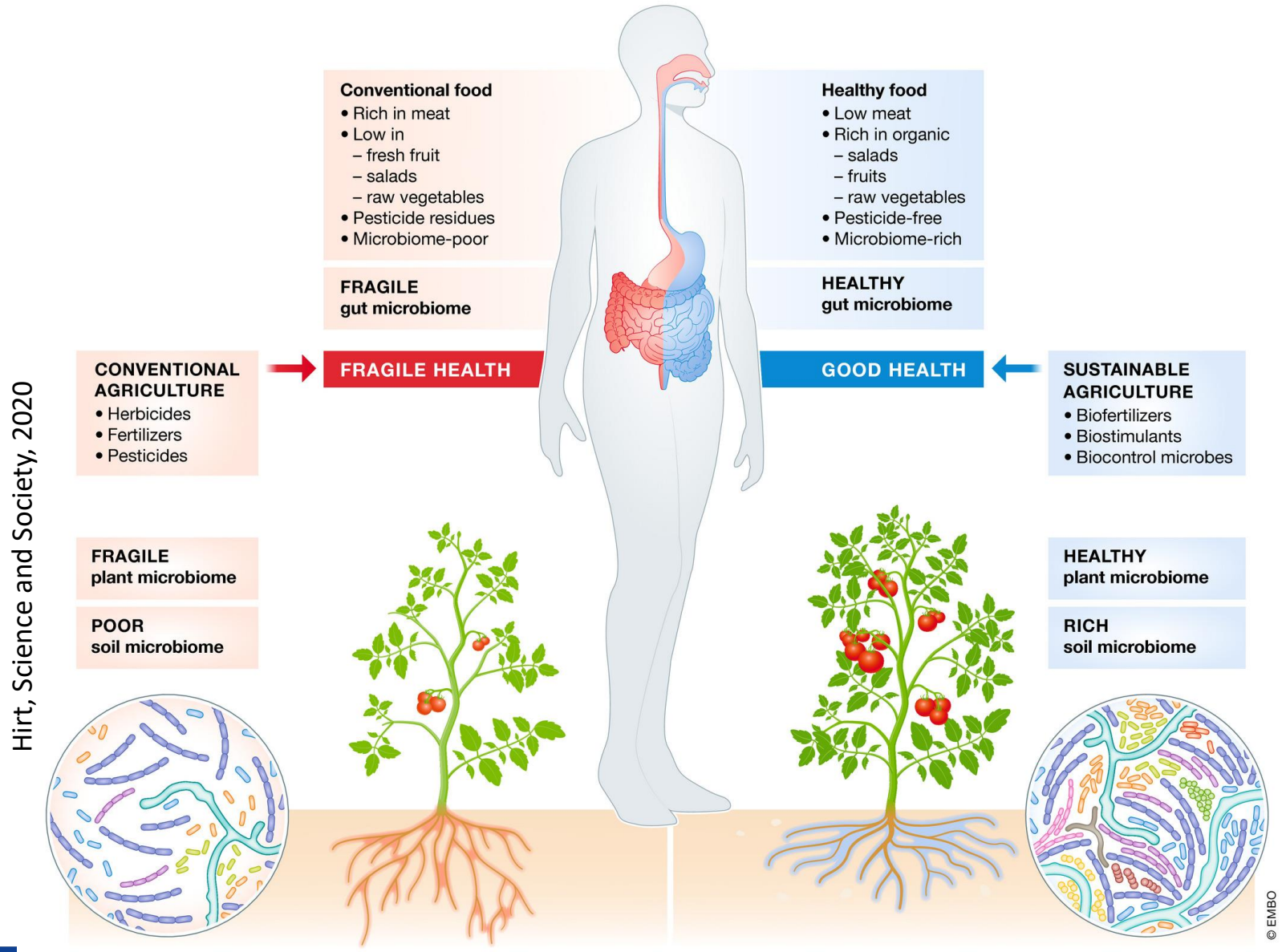
Microbiomes underpin plant and human health



Hirt, Science and Society, 2020

Medicine

Aquaculture

Biotechnology

Food: Production, sustainability and nutrition

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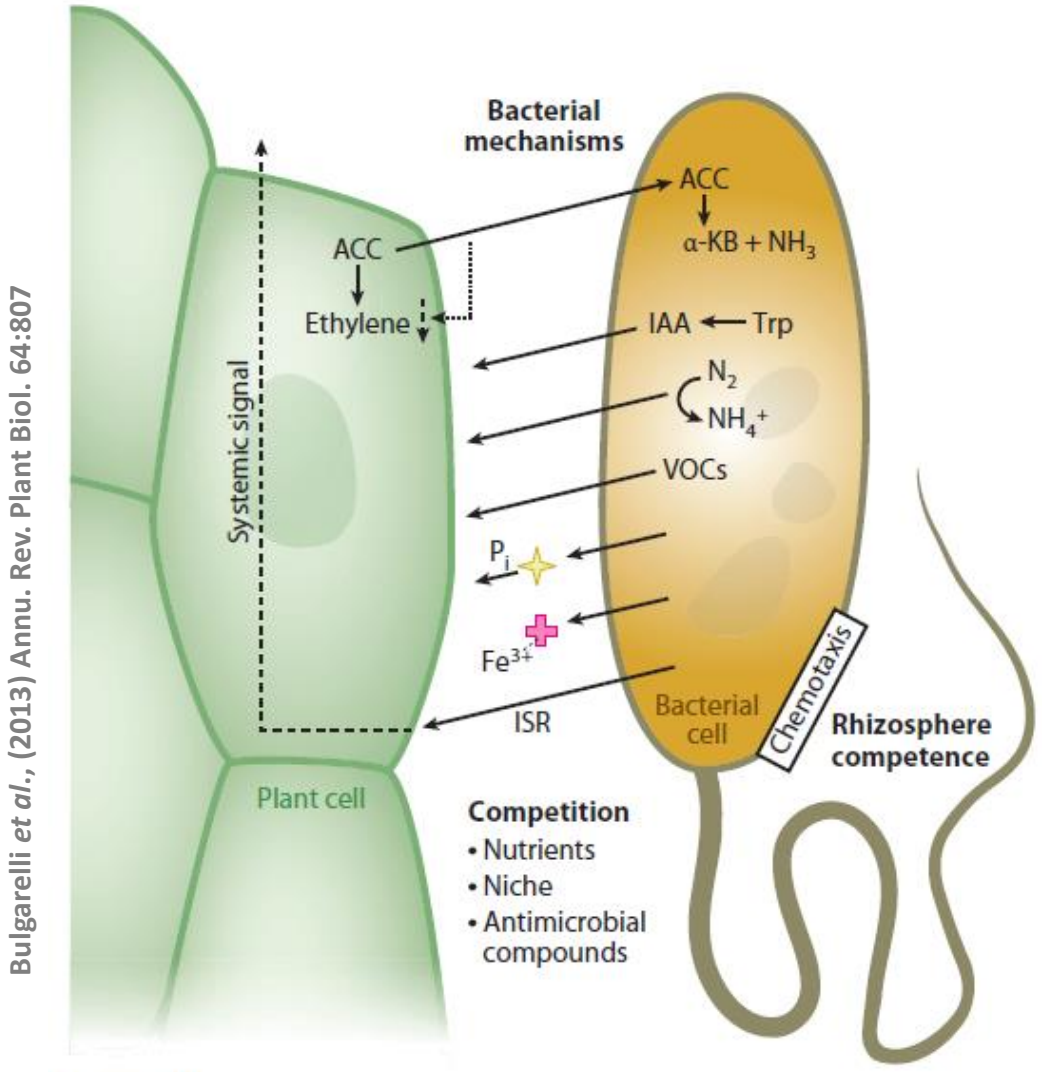
Plant growth-promoting microorganisms (PGPMs)



PGPMs key mechanisms:

Enhanced mineral uptake

Pathogen protection

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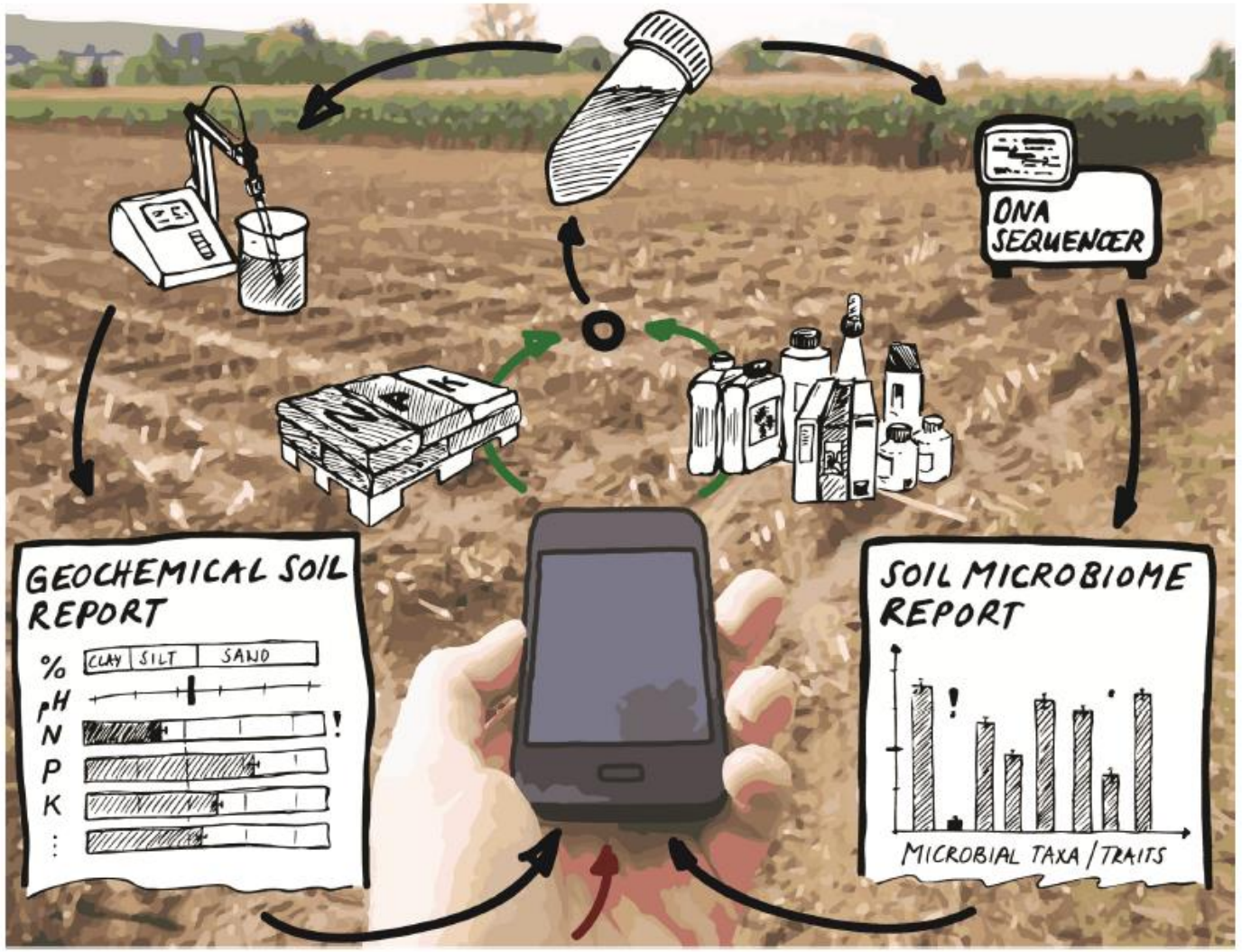
Towards next-generation agriculture



Schlaeppi and Bulgarelli (2014) , MPMI 28:212

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What is Circles ?

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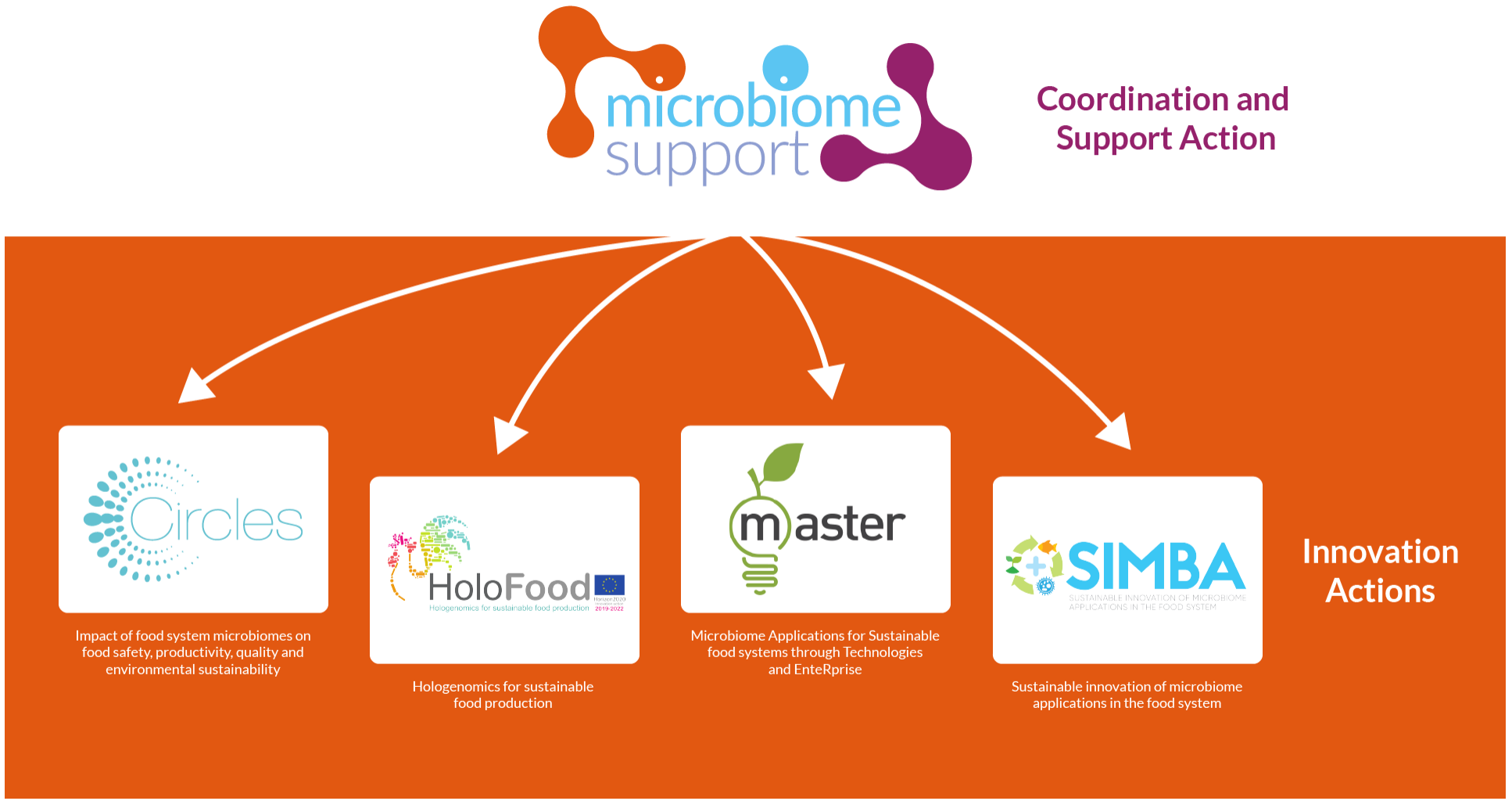
EU food-microbiome funding



€40M investment

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Who are CIRCLES?

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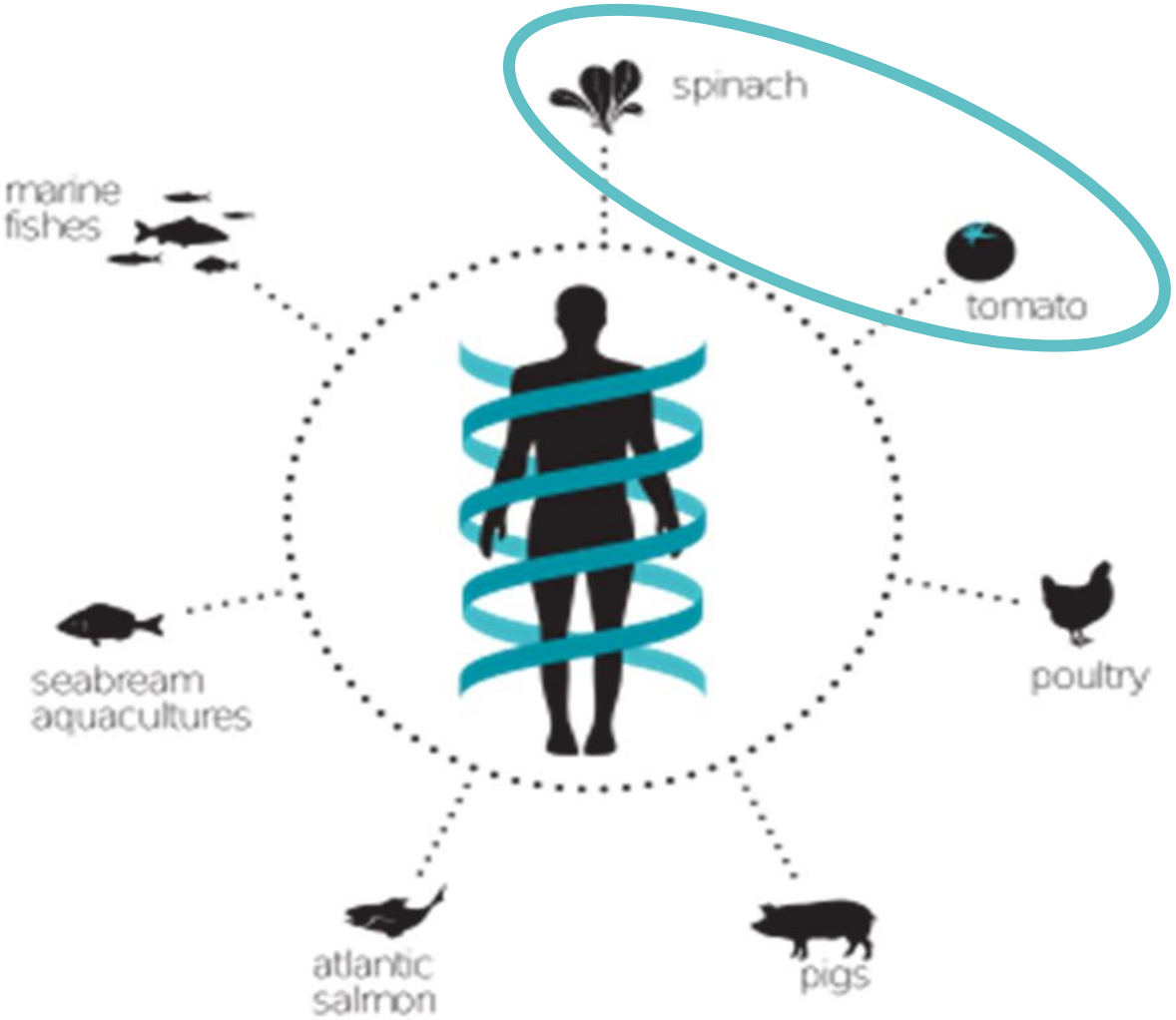
7 food systems



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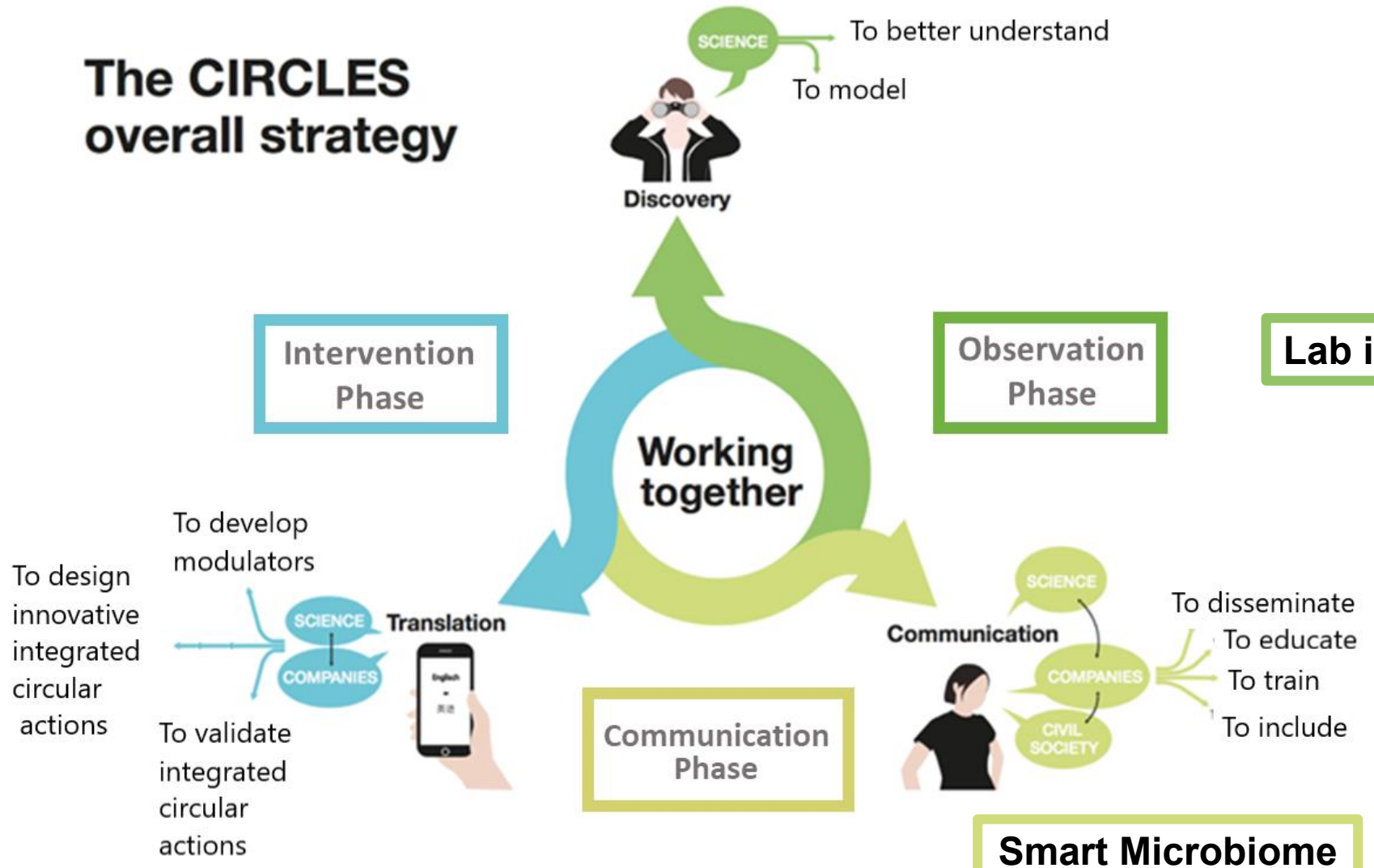
The three pillars of CIRCLES



Smart Microbiome Food products (SMFPs)

Microbe Transparent Labels MTLs

Lab in the field

Smart Microbiome Modulators. (SMMs)

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What makes Circles distinct ?

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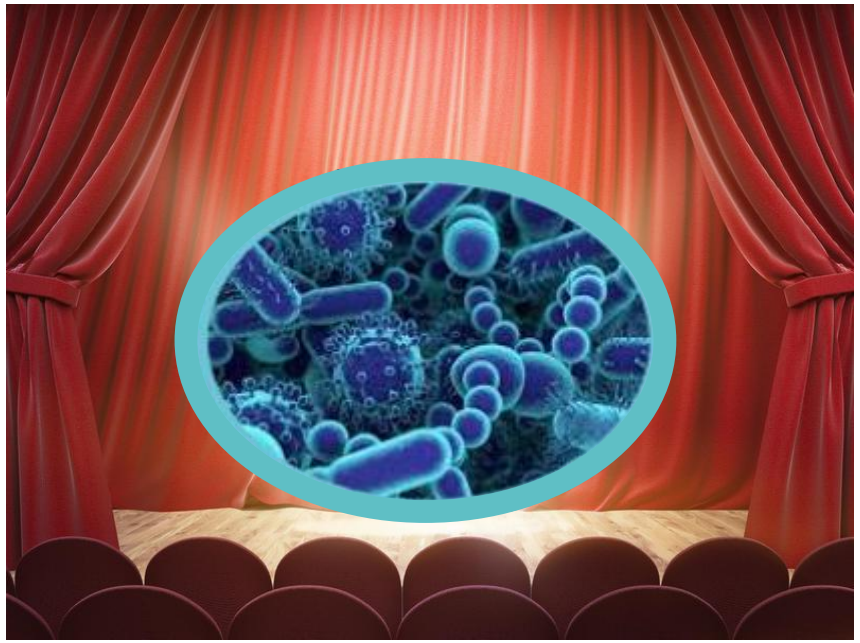
A team approach: Microbiomes as drivers of food production, quality and sustainability



Team work between researchers, farmers and companies to improve production, quality and sustainability

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Communication Strategies

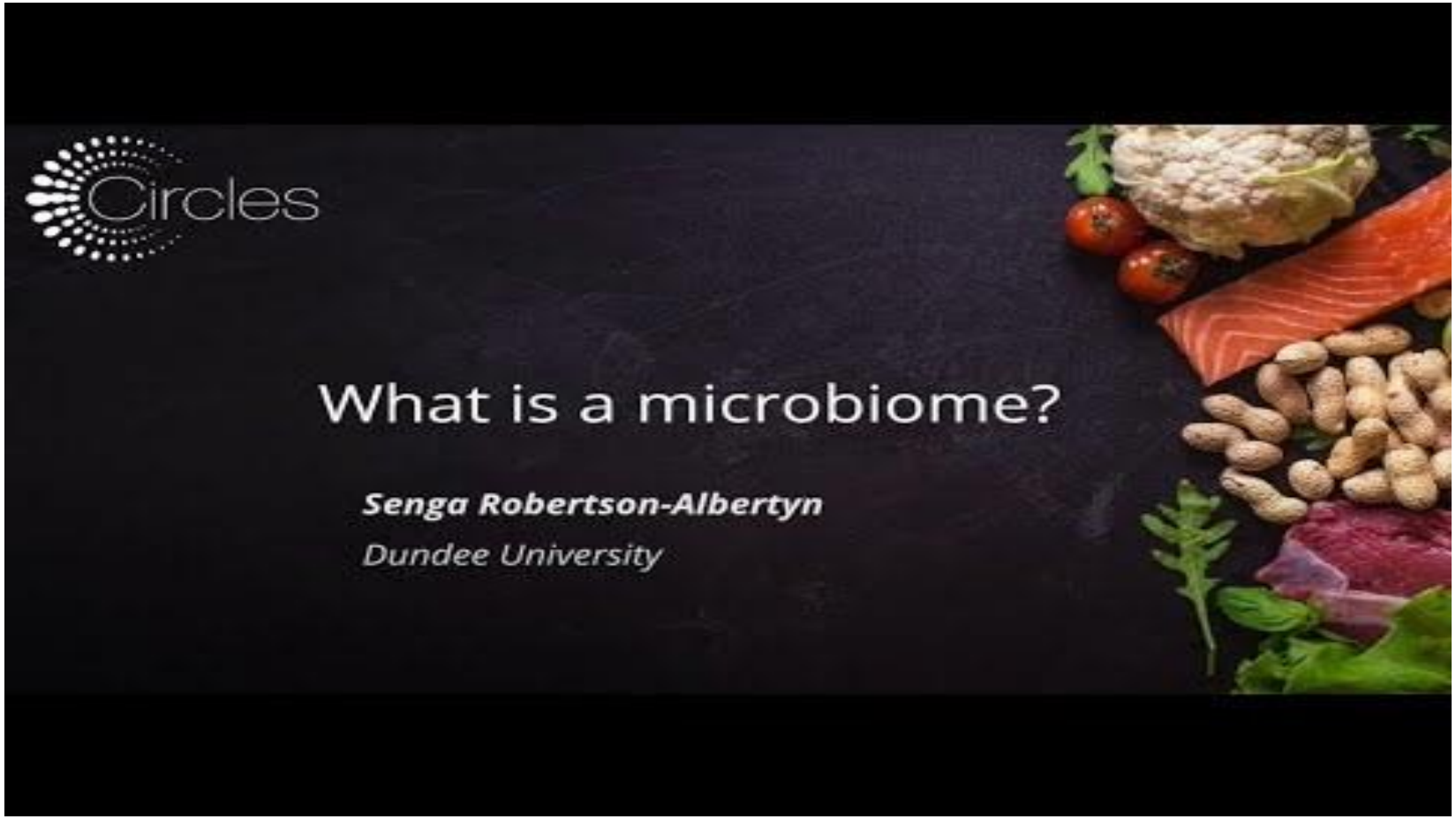
Social media toolkit for partners

Infographics

Videos

Blogs

Press Releases



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Labs in the field

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Where do we come in?

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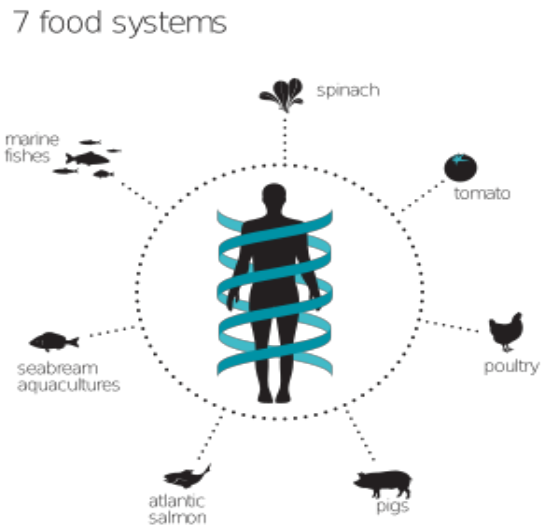
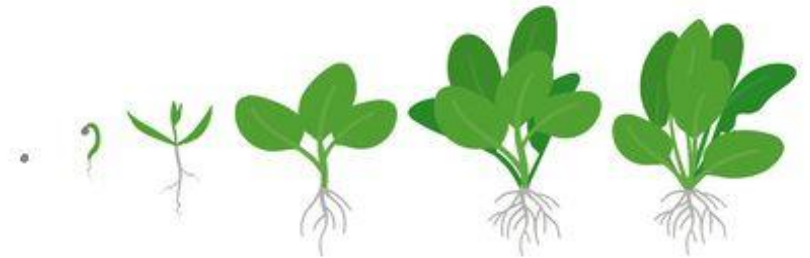
WP3: devising, applying & communicating Smart Microbiome Modulators in the Plant Food Chain





Spinach

Tomato

SMMs

SMFPs and MTLs

Kick off!

Observation phase

Intervention phase

T3.2: Microbiome profiling in the field (M8-39)

T3.5: Microbials (37-58)

T3.1: labs in the field (M6-7)

T3.3: Wastewater sampling (M8-58)

T3.6 Industrial derived (37-58)

T3.4: Mining microbial genomes (M20-37)

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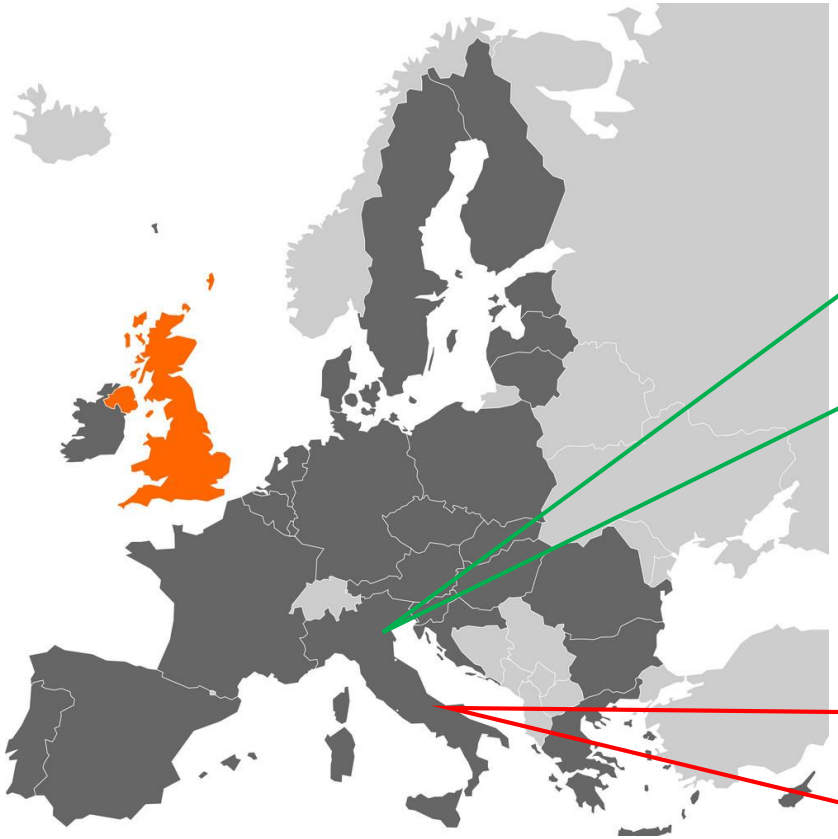
Labs in the field



2X Farms
In Northern Italy
Spinach
Partners:
OROGEL & UniBO

1X Farm
In Southern Italy
Tomato
Partners:
MS Biotech

…and counting: new farms engaged in the 2020-21 campaign!

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WP3 workflow

Analytical microbiome data identifying SMMs (smart microbiome modulators) from all food chain partners
collated by dedicated team to develop SMFPs (Smart microbiome food products) and MTLs (microbiome transparent labelling) in partnership with CIRCLES stakeholders.

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WP3 - Outreach

Provisional data

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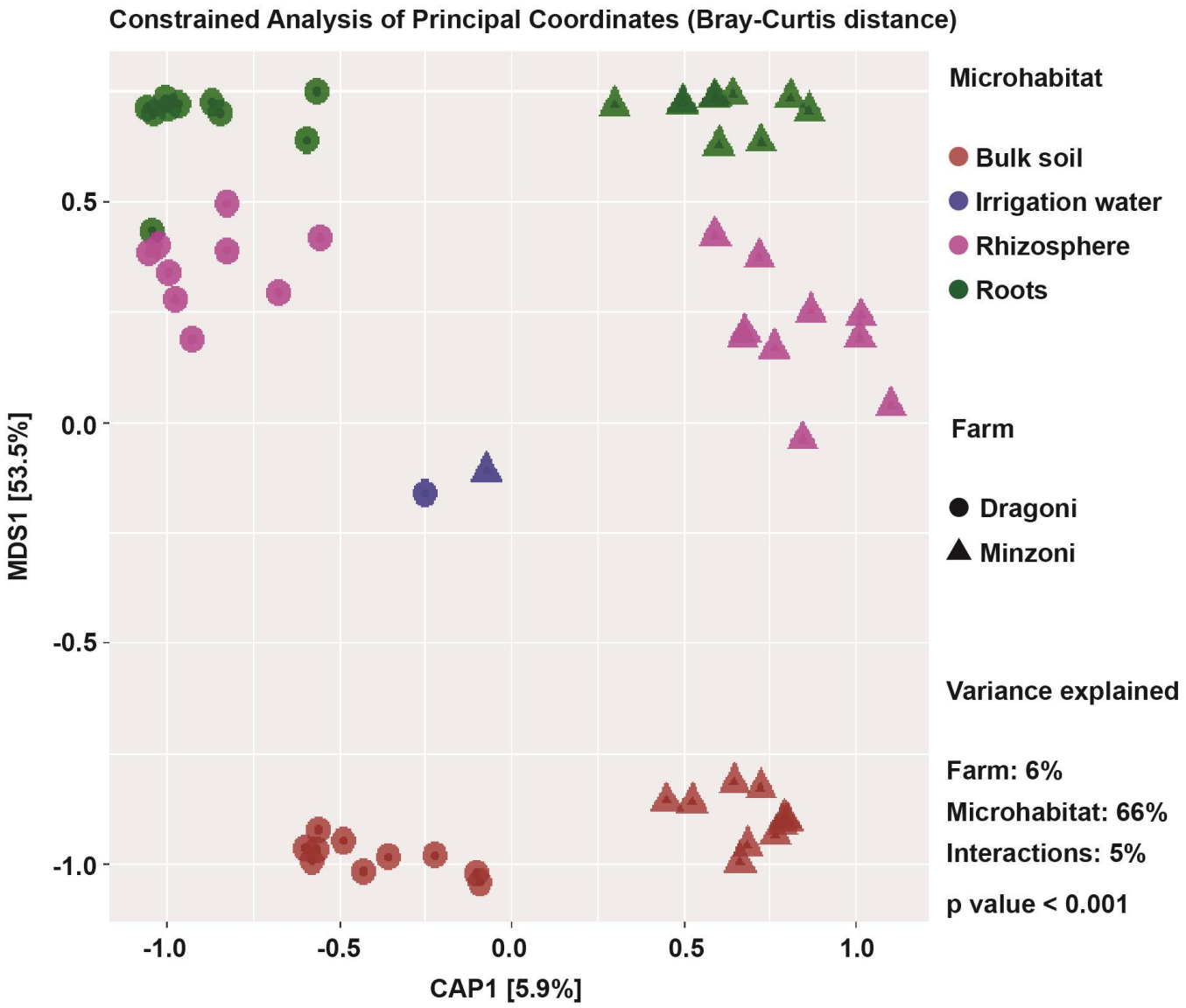
The microhabitat defines the spinach bacterial microbiota…
…and farm-to-farm variation fine-tunes its composition



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A selective bacterial enrichment underpins farm-to-farm variation

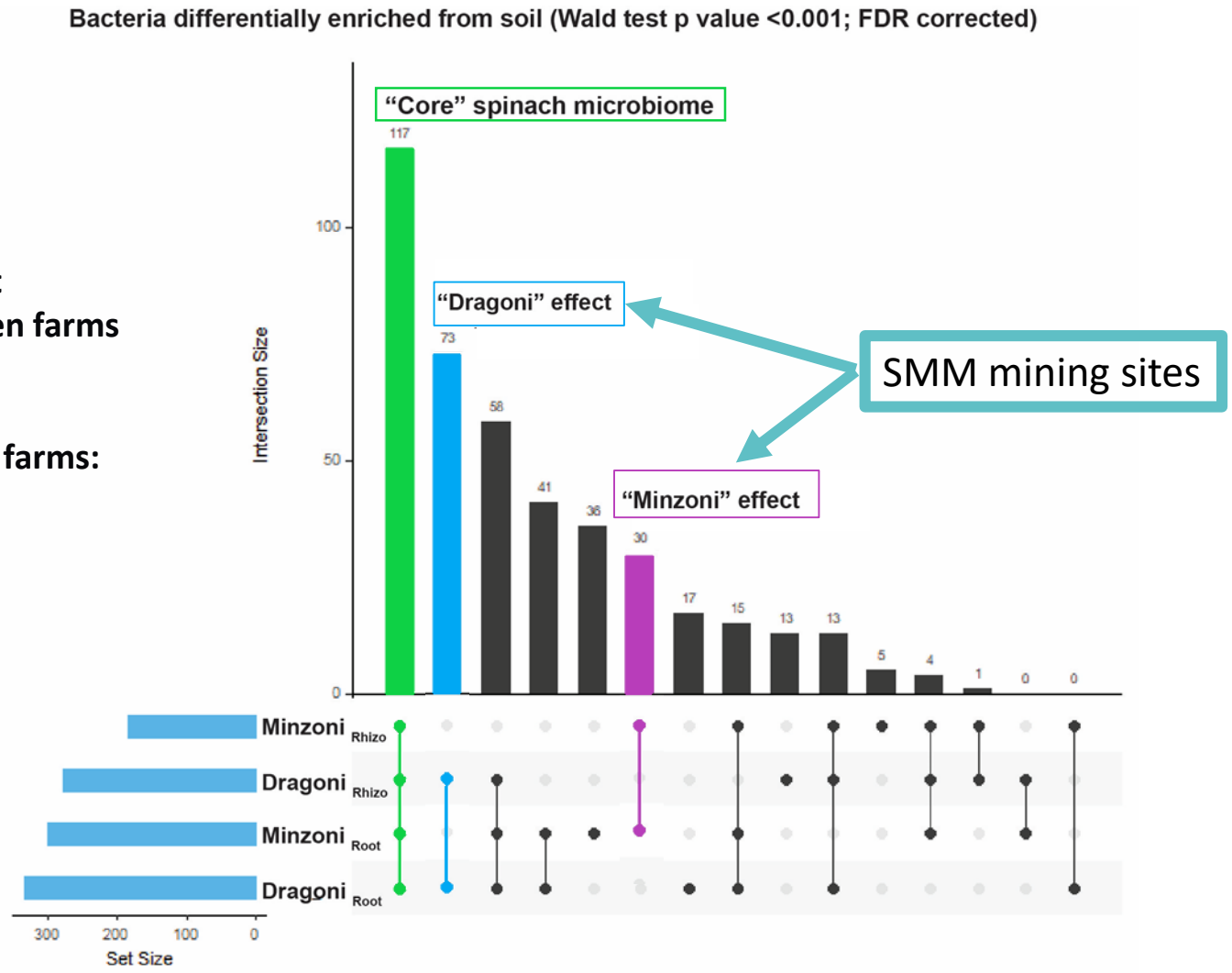
Key aspects:

Soil & management comparable between farms

Yield data between farms:

Dragoni ~25T ha^{-1}

Minzoni ~17T ha^{-1}



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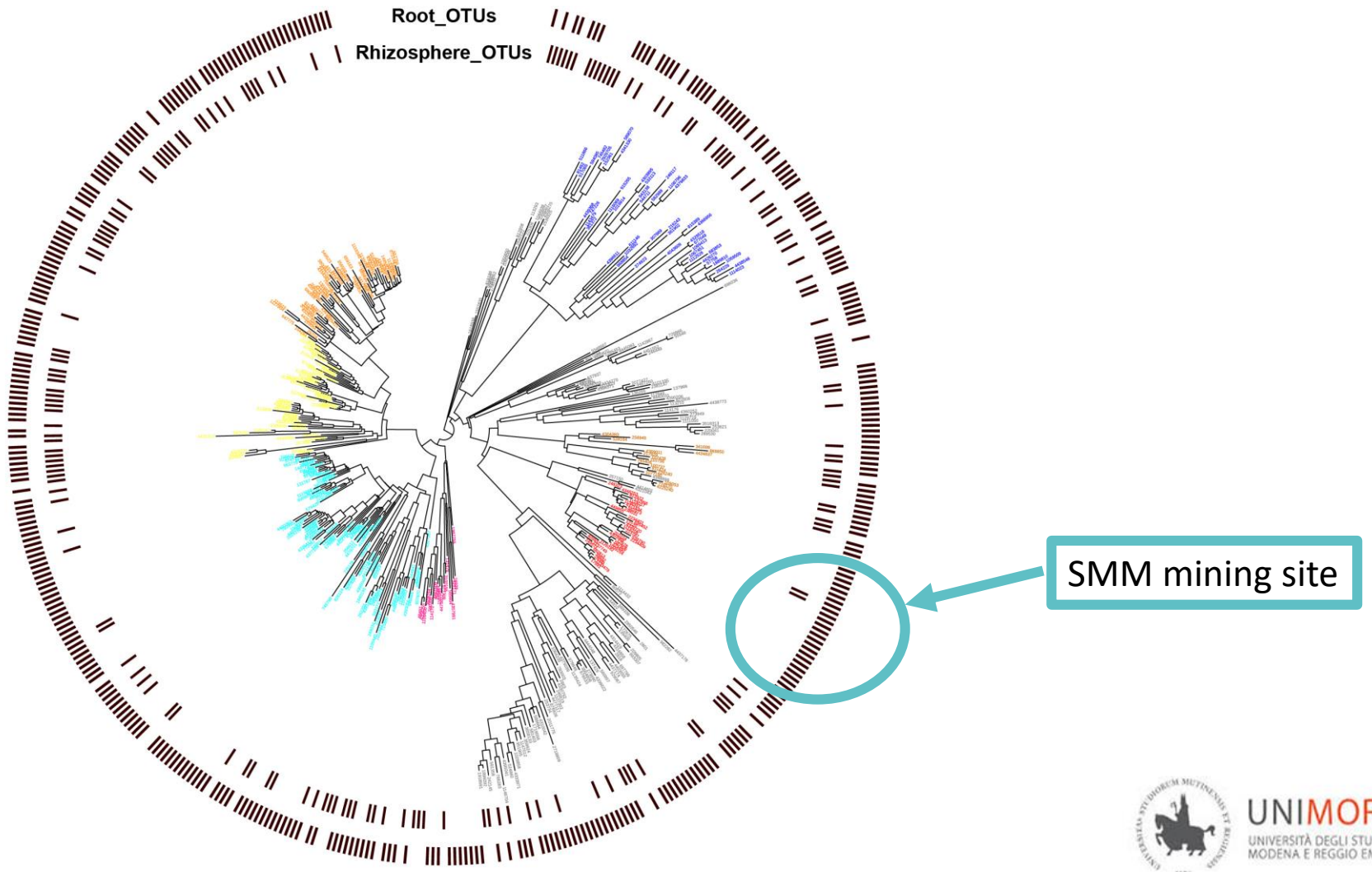
And the tomato microbiome for SMMs?



Caradonia *et al.*, (2019) Phytobiomes 3:4

UNIMORE
UNIVERSITÀ DEGLI STUDI DI MODENA E REGGIO EMILIA

Federica Caradonia
Enrico Francia

Where are we now?

2020-2021 Spinach samples harvested and en route to Scotland

2019-2020 Tomato library in preparation

ITS and Metagenomics approaches in preparation

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COVID-19: Challenges and opportunities

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COVID-19 Challenges

Agricultural partners furloughed - 2020-2021 Tomato harvest lost

Some partners redeployed to COVID - 19 sequencing - indirect impact

2019-2020 Tomato library processing delayed - COVID-19 “quarantine”

But now, let’s look at the opportunities

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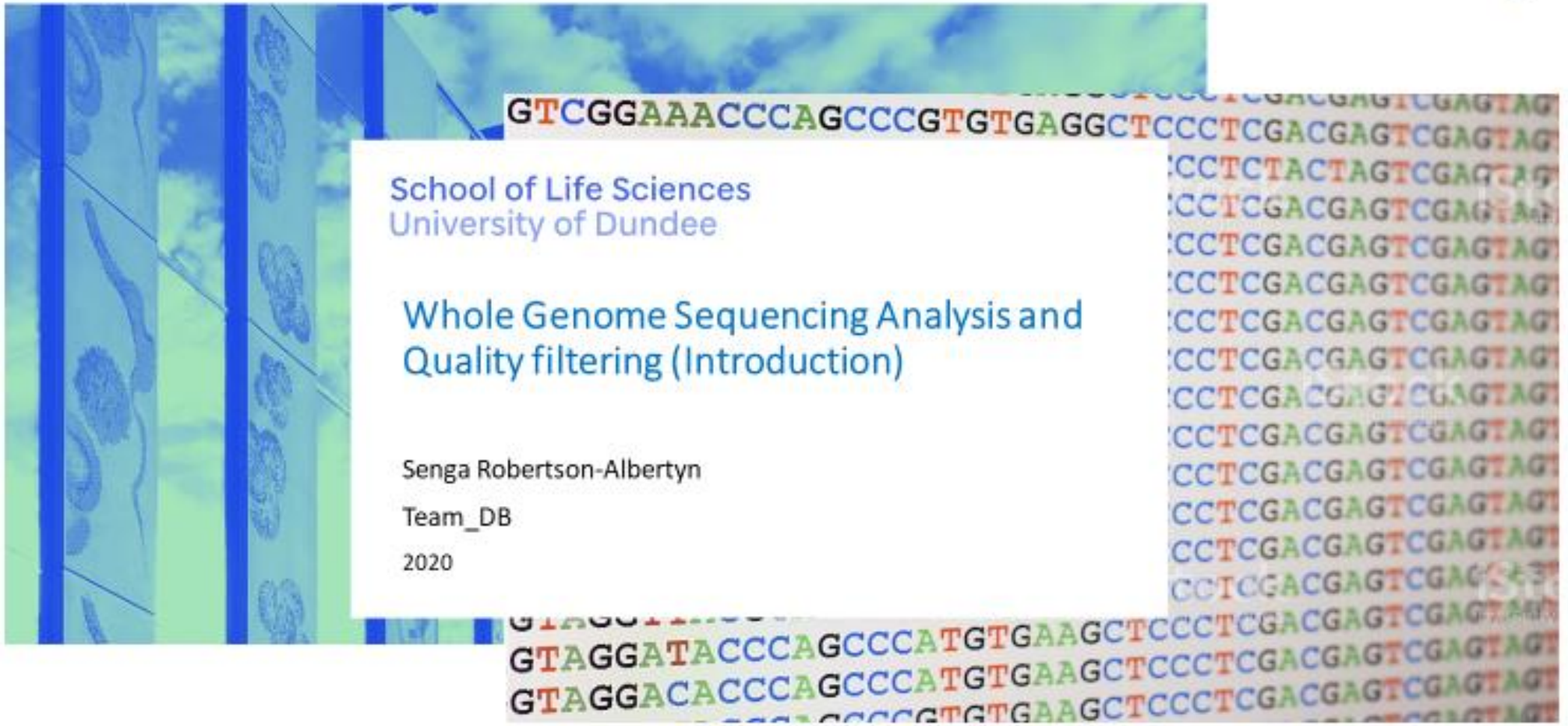
Assembly analysis and quality filtering toolkit for partner organisation

- University of the Year for Student Experience (*The Times/Sunday Times Good University Guide 2020*)



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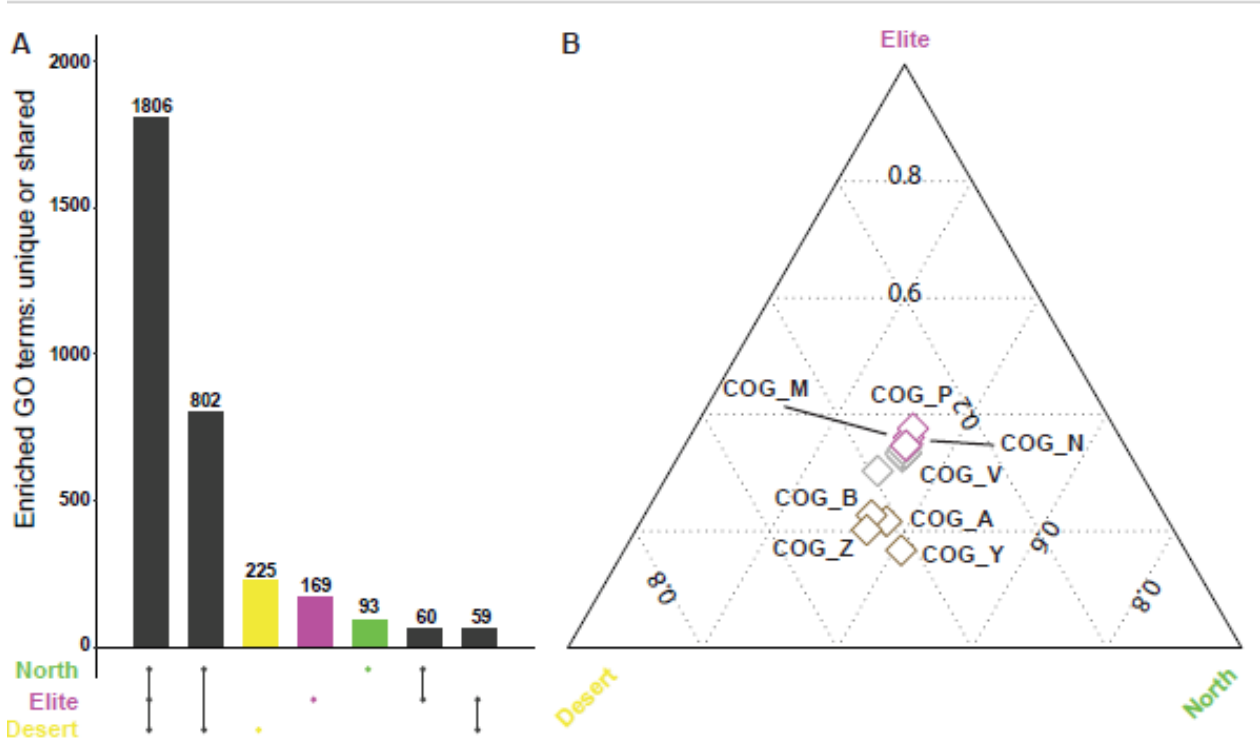
From taxonomy to functional potential



C

Wild enriched	Elite enriched
COG_A: RNA processing and modification	COG_M: Cell wall/membrane/envelope biogenesis
COG_B: Chromatin structure and dynamics	COG_N: Cell motility
COG_Y: Nuclear structure	COG_P: Inorganic ion transport and metabolism
COG_Z: Cytoskeleton	COG_V: Defense mechanisms

James Abbott

https://www.biorxiv.org/content/10.1101/605204v2

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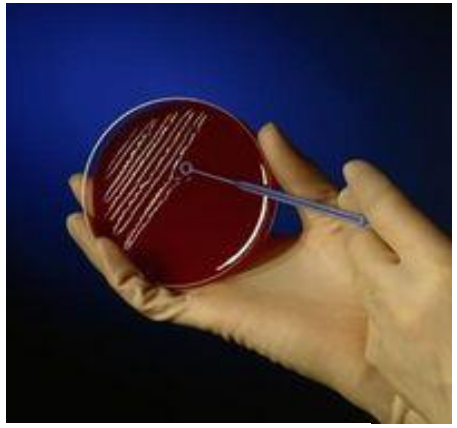
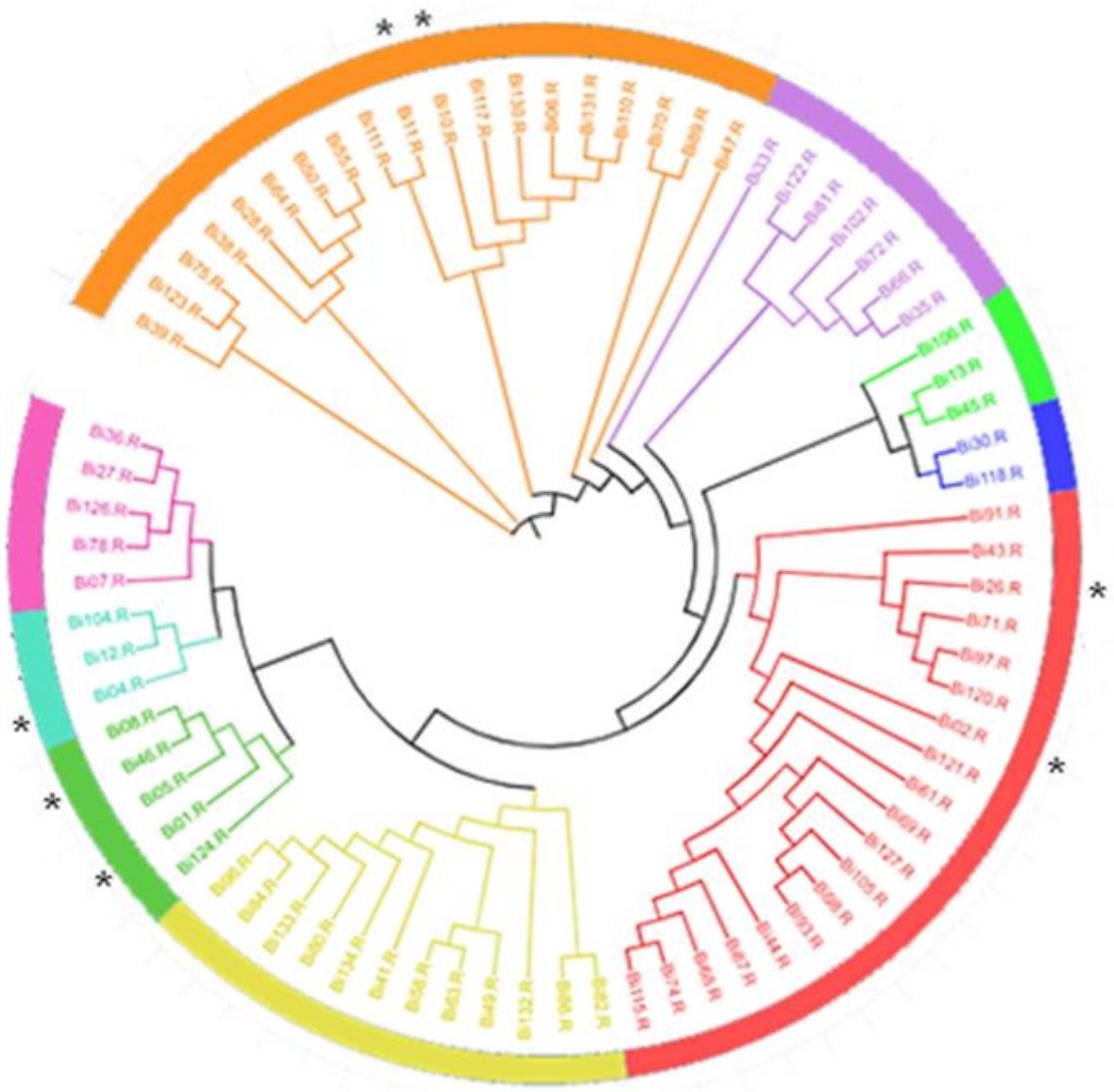
Optimisation and verification of bacterial inoculant approach



Rumana Kapadia



- Pseudomonadales
- Xanthomonadales
- Enterobacteriales
- Burkholderiales
- Actinomycetales
- Bacillales
- Rhizobiales
- Flavobacteriales
- Sphingobacteriales

Genera of the bacterial isolates selected:

- Arthrobacter
- Clavibacter
- Chryseobacterium
- Pseudomonas
- Rhizobium

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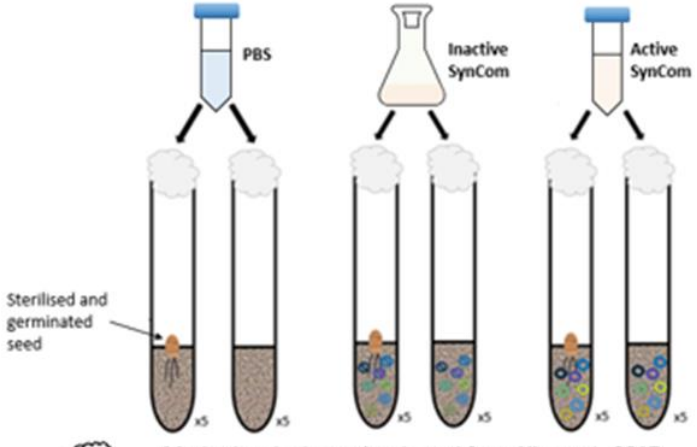
Optimisation of bacterial SynCom inoculant approach

Sterilised and germinated seeds

Seeds sterilisation and germination

Inoculum preparation



Method and schematic adapted from Niu *et al.*, 2017

Tube inoculation

Rhizosphere fractionation

Down stream analyses

Steven Jagline

Rumana Kapadia

Rapidly assess inoculant viability and efficacy to produce SMFPs

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Summary

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CIRCLES

Innovative collaboration between researchers, farmers and companies to achieve food production and productivity goals.

Bringing the lab to the field.

Tracing microbiomes through food systems to identify Smart Microbiome Modulators (SMMs).

SMMs used to produce Smart Microbiome Food Products (SMFPs) and Microbiome Transparent food labels (MTLs).

Leading technology, facilities and expertise.

Improving food nutrition and sustainability in Europe.

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Thank You

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Davide Bulgarelli (Principal investigator)

James Abbott (Senior Bioinformatician)
Rodrigo Allegria Terrazas (Associate member)
Lynn Brown (hons Student)
Federica Caradonia (UniMore)
Aileen M Corral (Technical Assistant)
Carmen Escudero-Martinez (PDRA)
Steven Jagline (MSc student, U Rennes)
Rumana Kapadia (hons and MSc Student)

All CIRCLES project partners

Horizon 2020
European Union funding
for Research & Innovation

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Questions?

Find out more or contact us anytime

https://circlesproject.eu/

https://www.microbiomesupport.eu/

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