Agroécologie Dijon Unité de Recherche

AGRO SUP DIJON | INRAE | uB | UBFC Université Bourgogne Franche-Comté

INRAE HOLOFLUX Metaprogramme

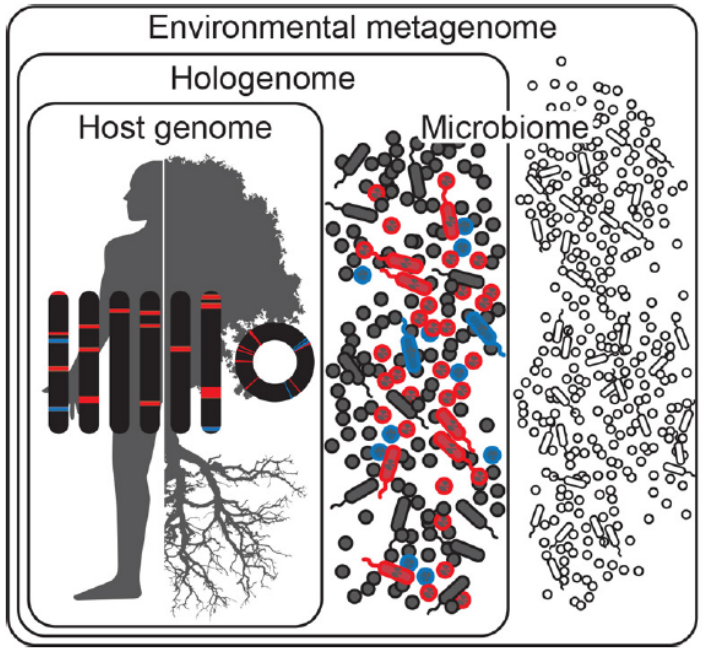
PHYTOBIOMES ALLIANCE

Holobionts and microbial flux within agri-food systems

Manuel BLOUIN, Professor of Ecology at AgroSup Dijon

Microbial communities in the rhizosphere: a selection unit?

Selection of microbial communities in the holobiont context



The holobiont: the animal or plant with all of its associated microorganisms

Holobiont = ***the* unit of selection in evolution** => Debate

Zilber-Rosenberg & Rosenberg (2008) FEMS Microbiology

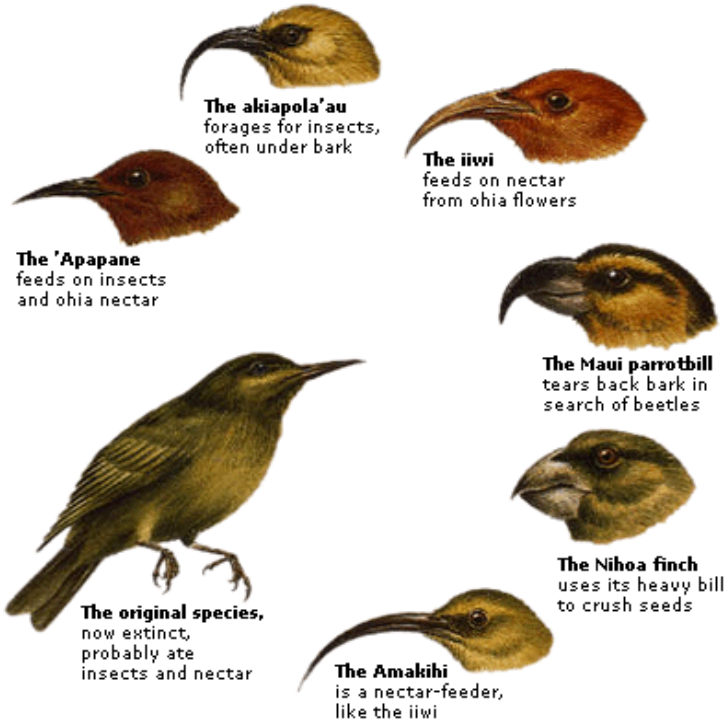
First: Can a microbial community be a unit of selection?

To answer positively, microbial communities should respect the criteria stated by Lewontin (1970):

- Variation
- Fitness change
- Heritability => stability in microbial community structure

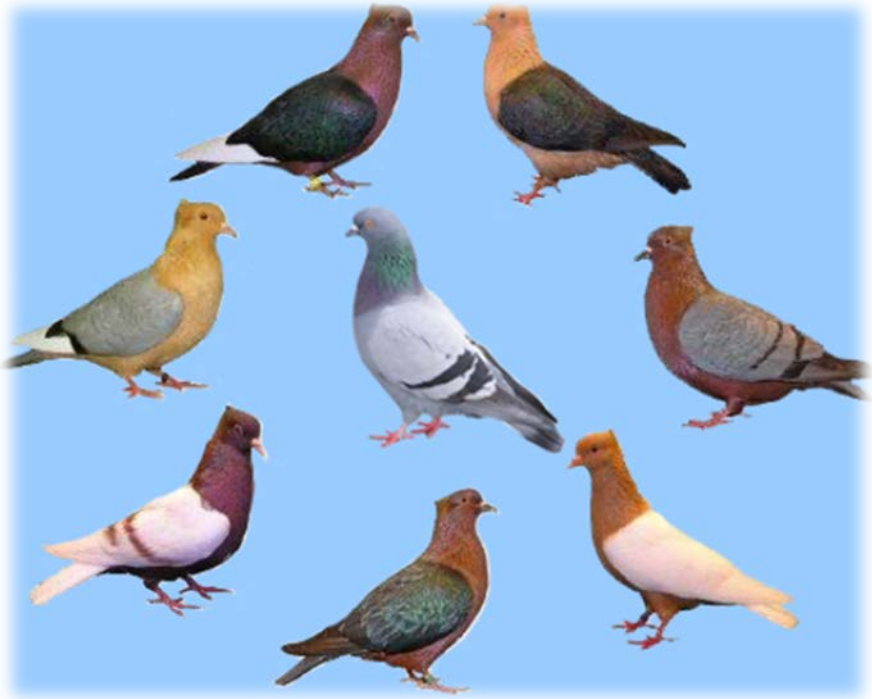
Empirical demonstrations of selection at the individual level

Natural selection



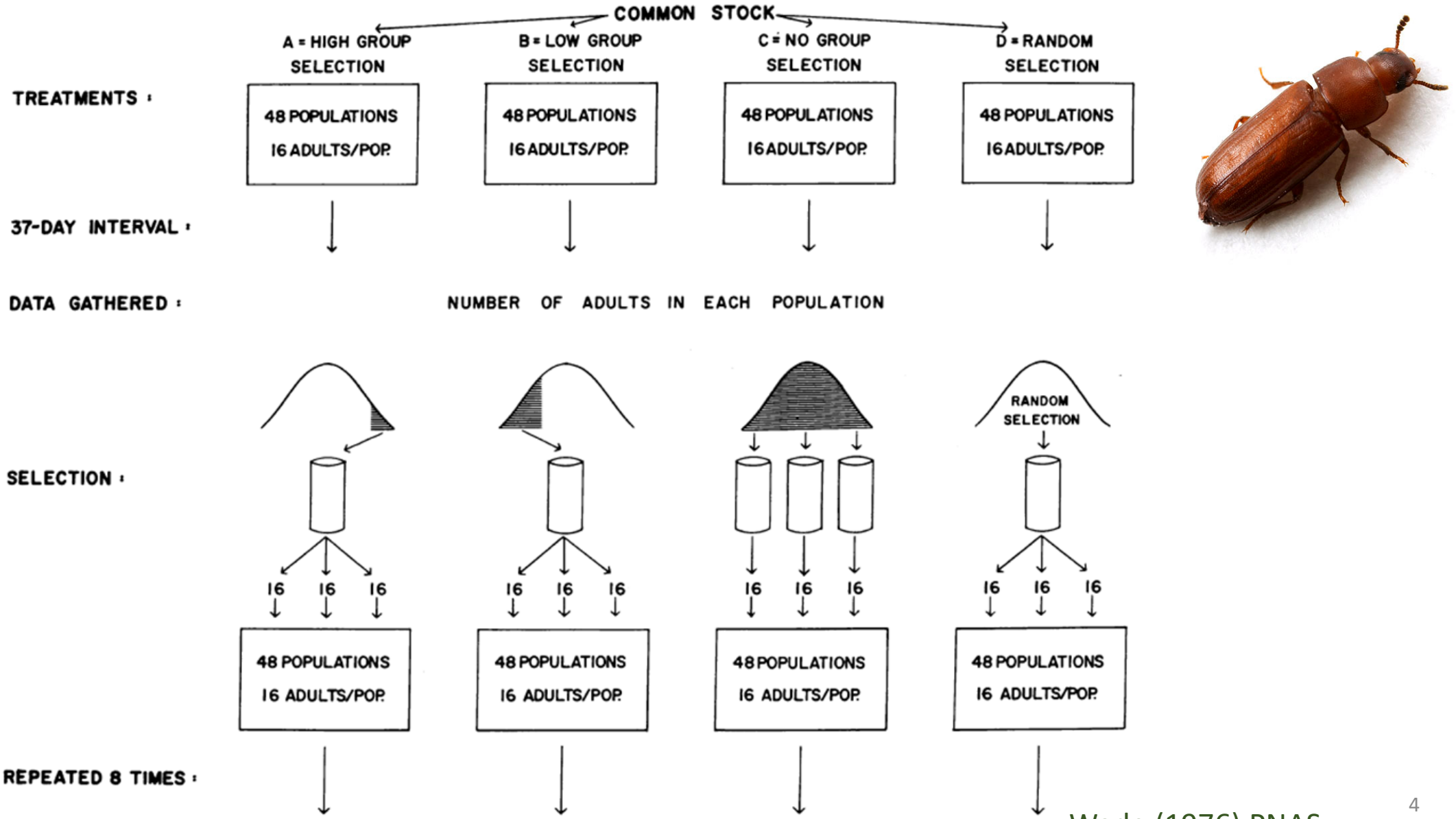
Darwin's Galápagos finches

Artificial selection



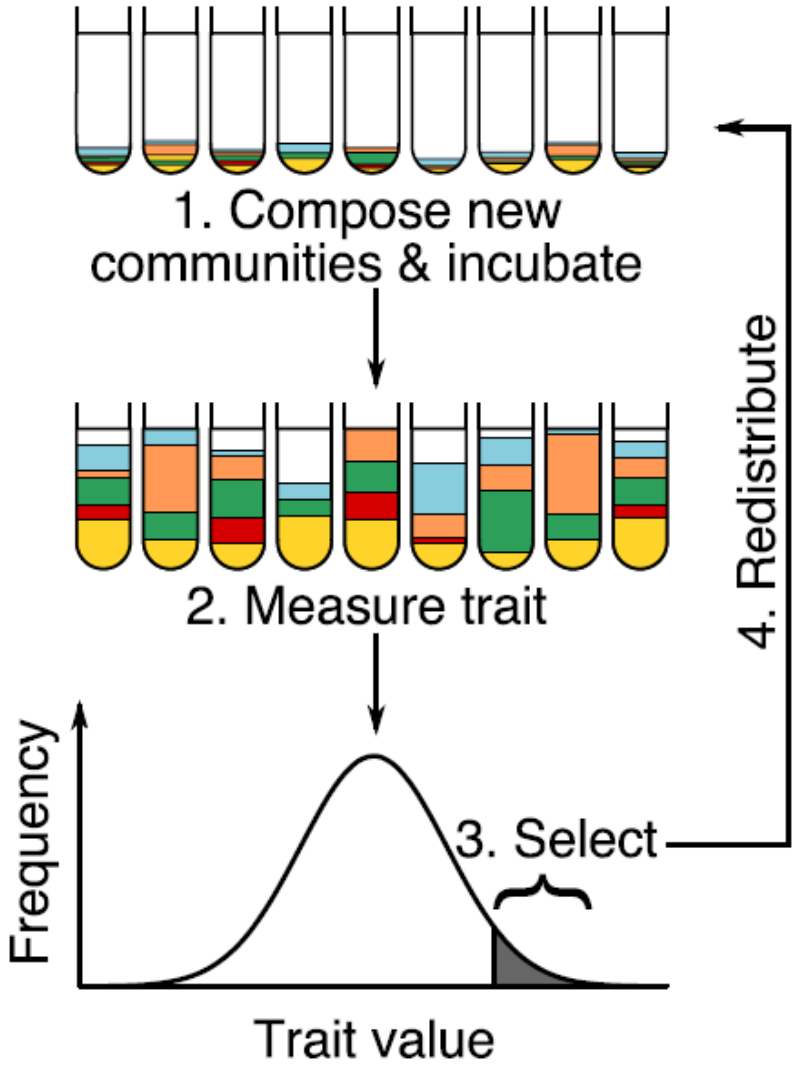
Darwin's other birds: pigeons

Protocol for artificial selection of groups



Wade (1976) PNAS

Protocol for artificial selection of microbial communities



Airas-Sanchez & Mitri (2019) PLoS Biology

Artificial selection of rhizospheric communities associated with changes in plant greenness

Species:
Soil microbial community & the plant *Brachypodium distachyon*

Selected trait:
Non destructive greenness index (green intensity & leaf area) related to N-uptake

Design:
3 treatments (random selection control + high and low greenness treatments)
3 lines of 20 plants per treatment

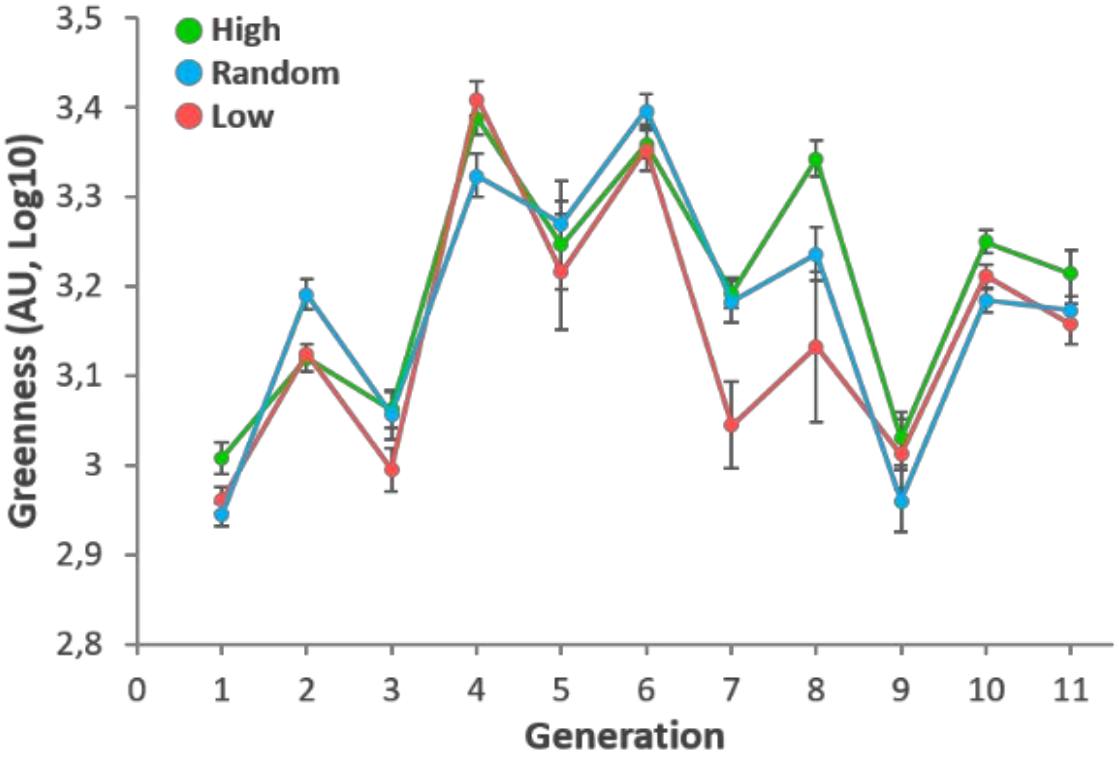
⟹ Plants
always from the same seed batch

⟹ Rhizosphere microbial communities
transfered between generations

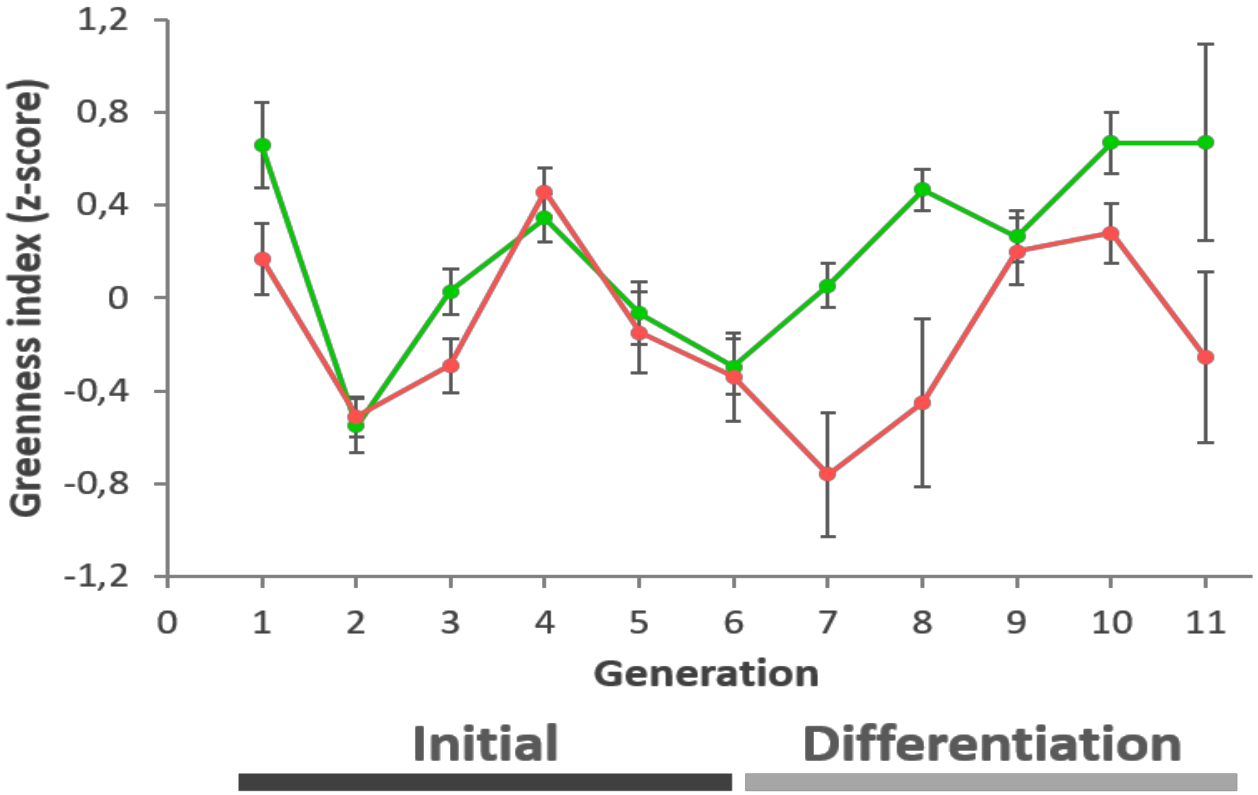
Phenotyping platform (4PMI) of INRAE Dijon
UMR Agroécologie

Plant trait

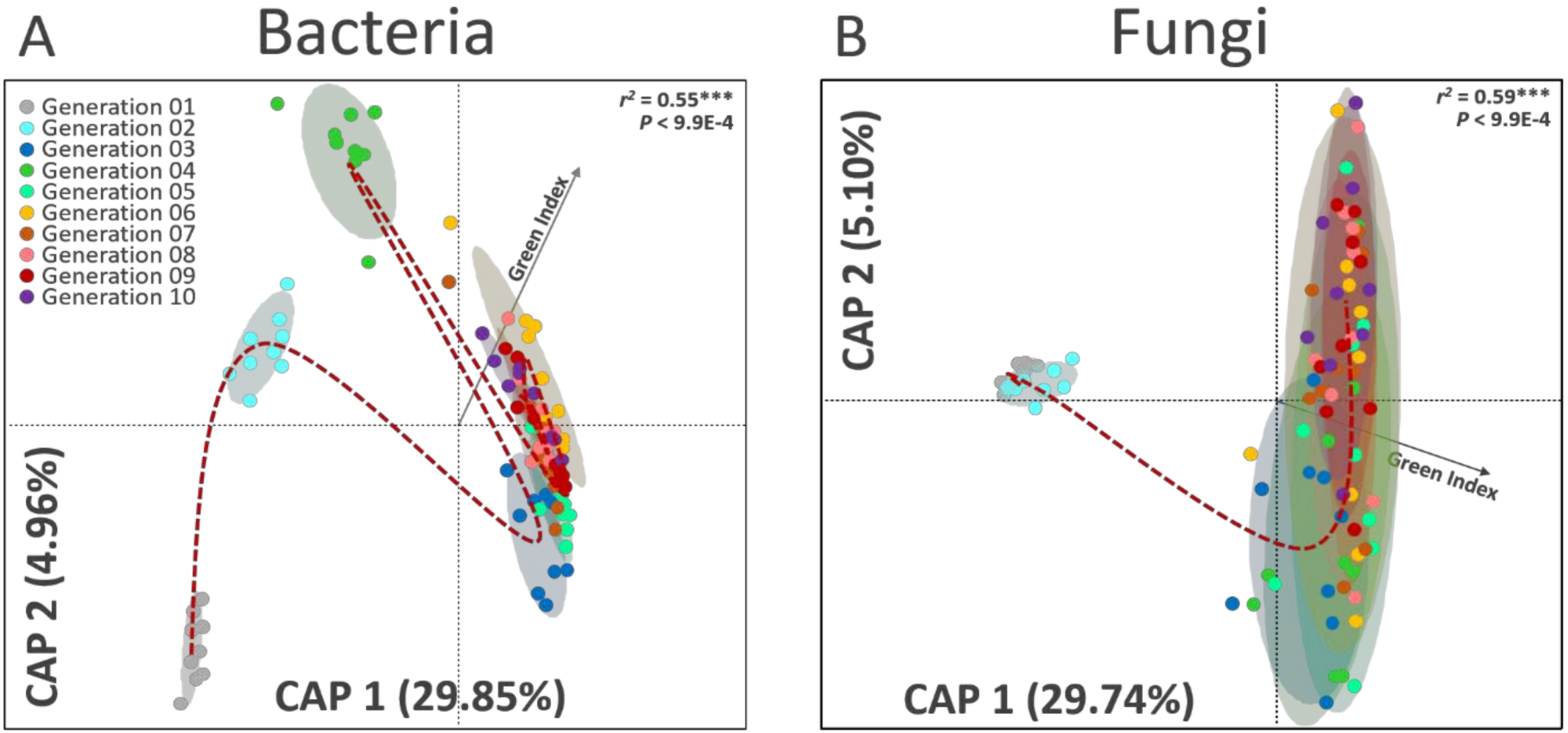
Rough data



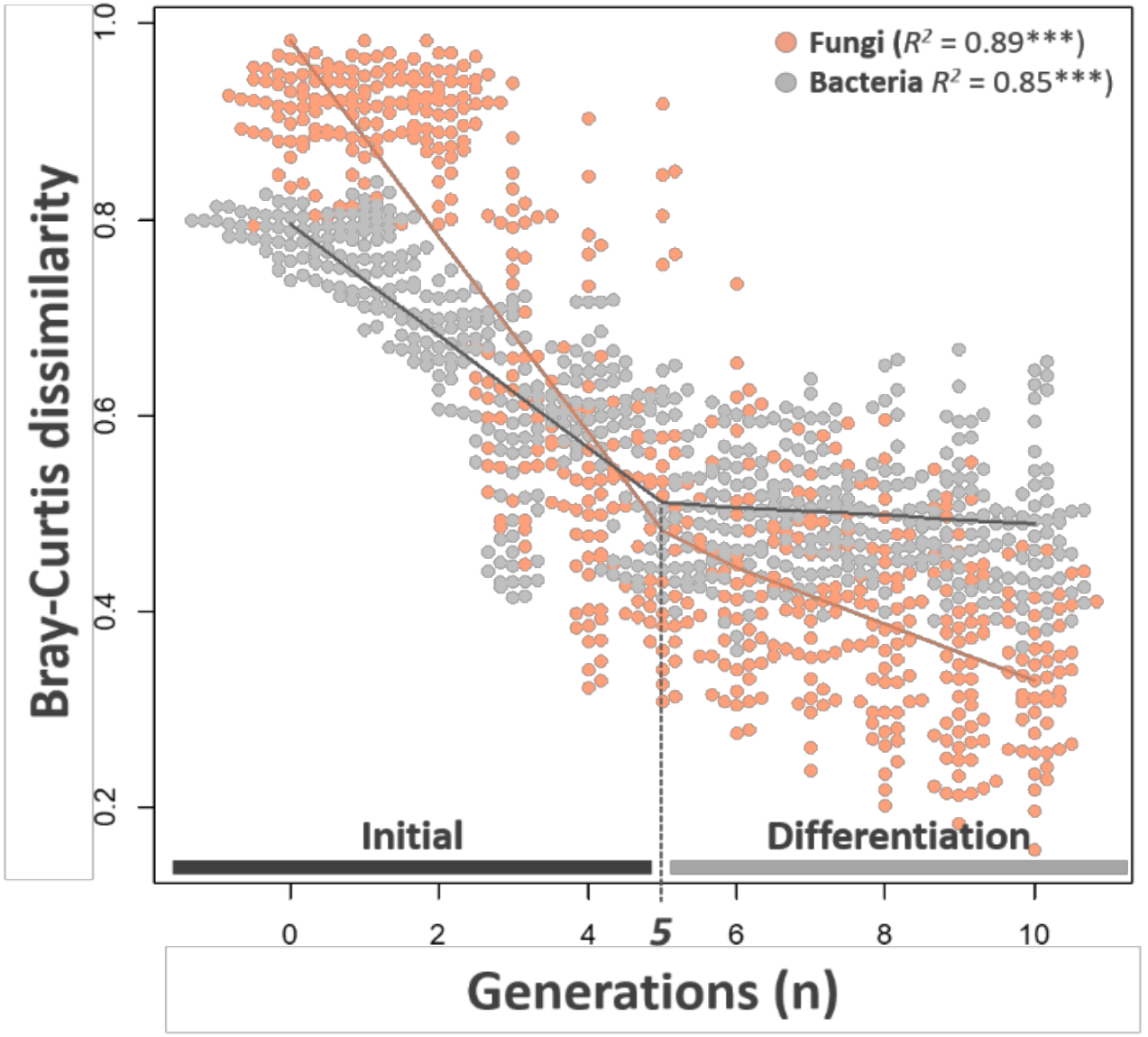
Normalized with the control



Stabilization of microbial community structure through generations

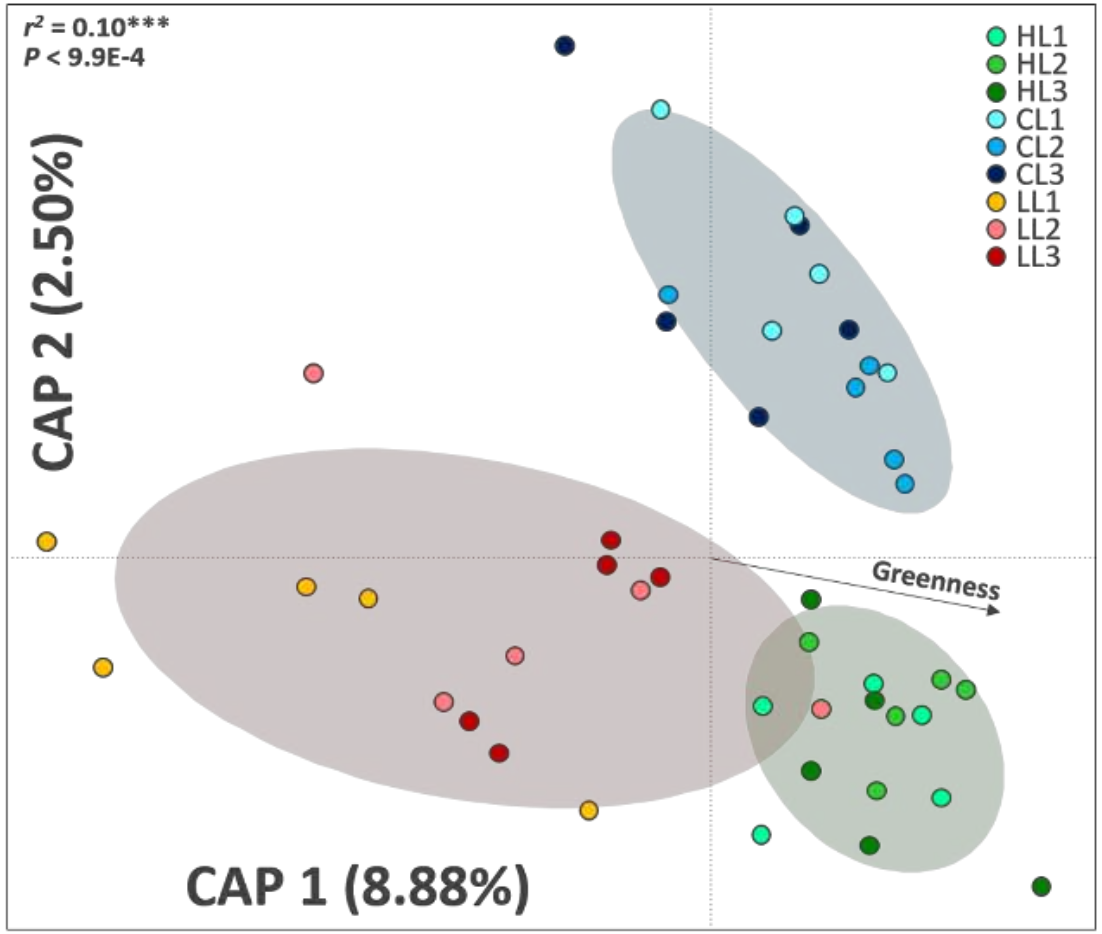


Stabilization of microbial community structure through generations

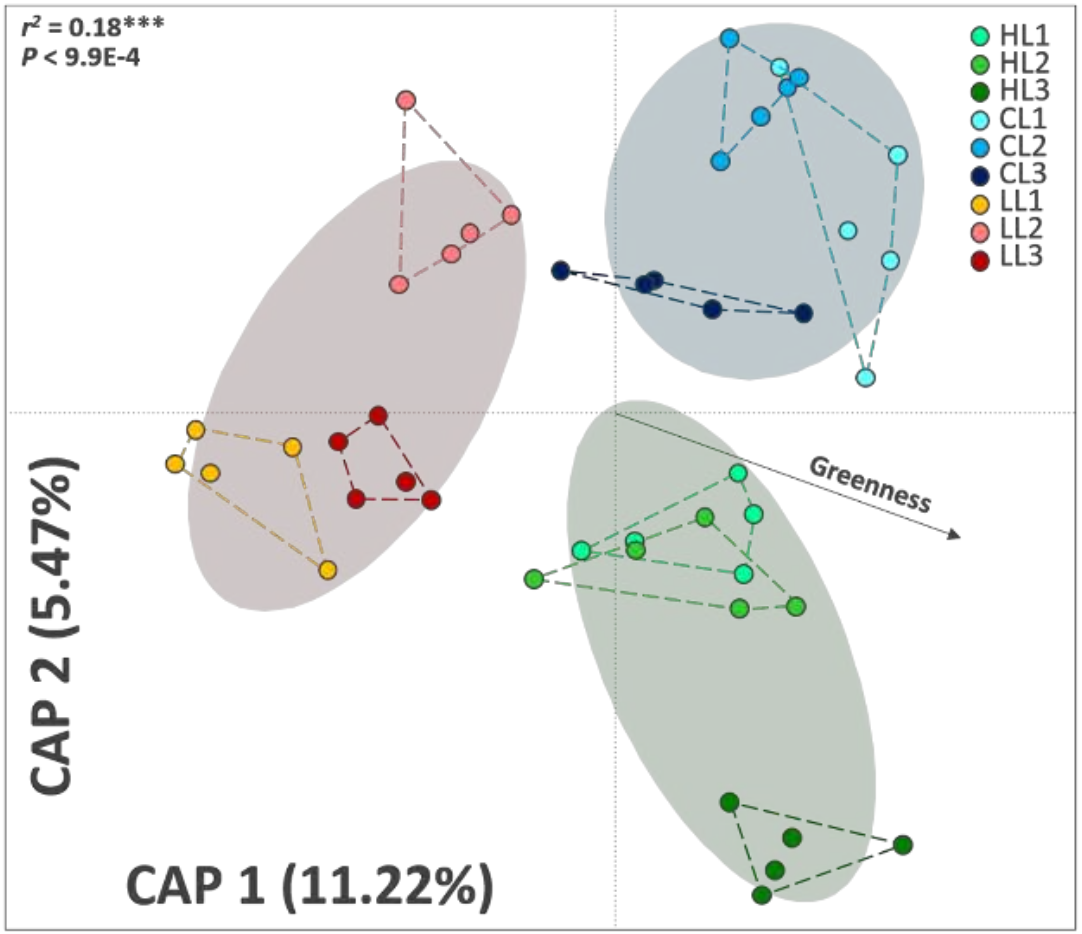


Microbial community structure in the different treatments

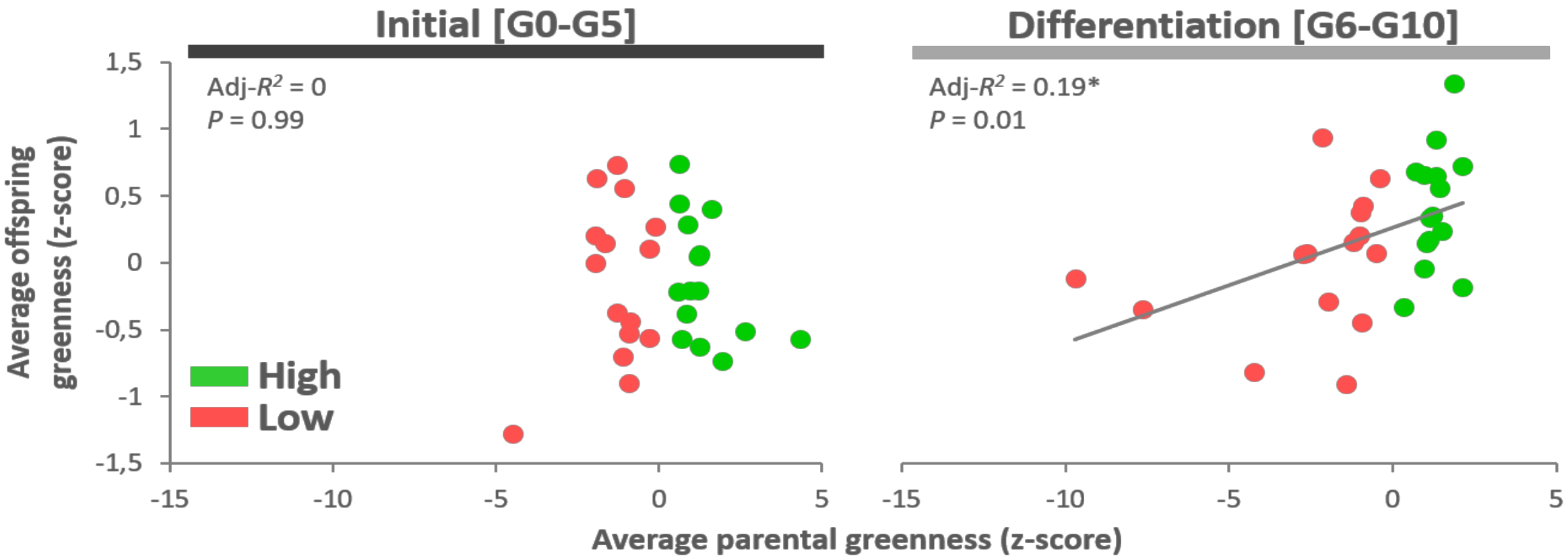
A Bacterial pools [G06-G10]



B Fungal pools [G06-G10]



Heritability of plant trait



Conclusions

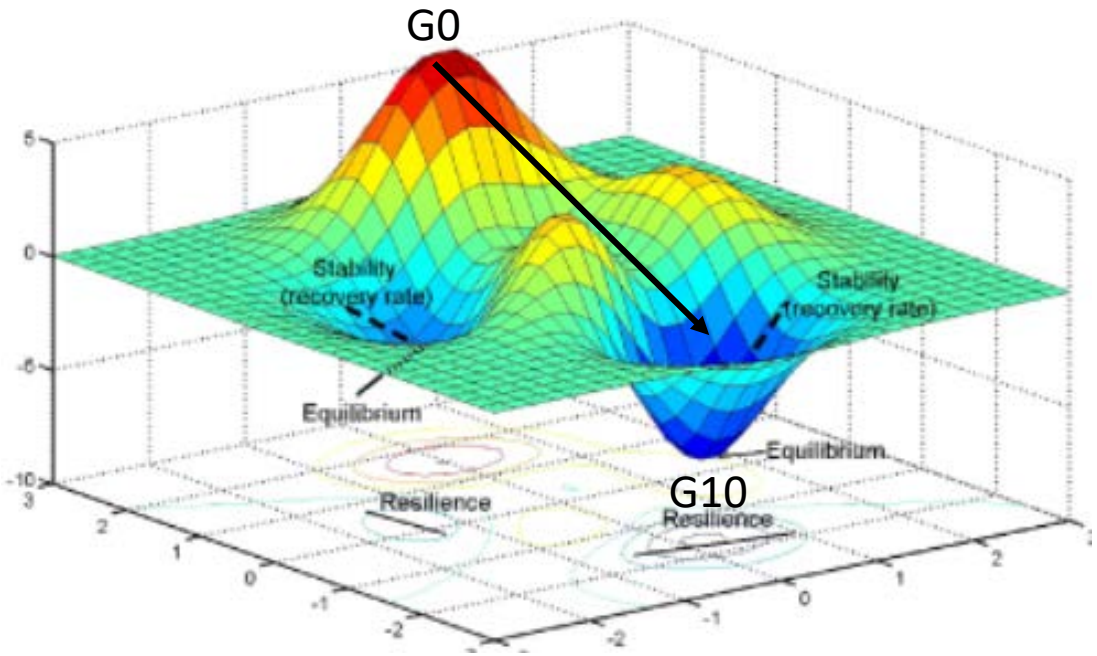
Rhizospheric communities can be selected
for their impact on plant phenotype.

A stabilization of microbial community structure
can arise after several generations.

When stabilization occured,
modification in plant trait became heritable.

Criteria of Lewontin (1970) are fulfilled.

Rhizospheric microbial community can be a
selection unit, if we can stabilize their structure.



Perspectives

⇒ Theoretical interest for debate about the nature of selection units in evolution

⇒ Practical interest for agriculture (and medecine)

Acknowledgements

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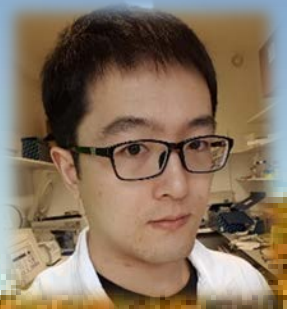
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