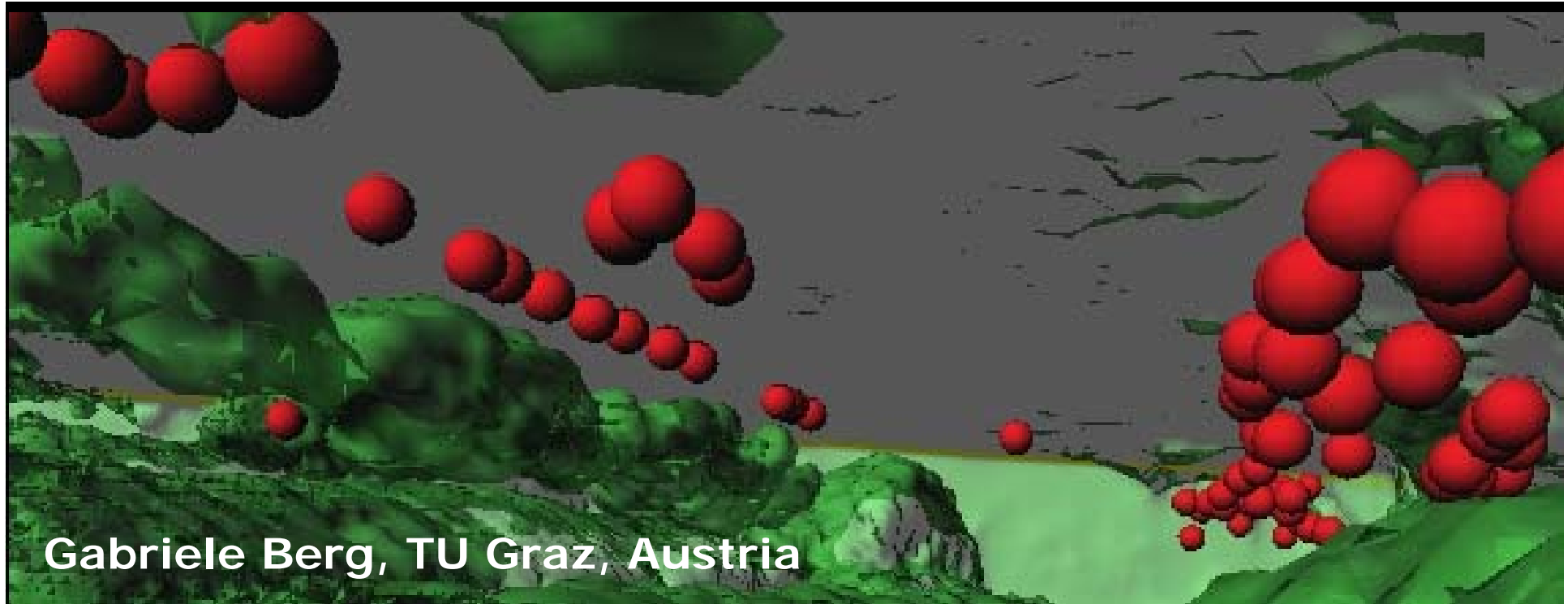


Novel modes of plant-microbe interaction discovered by omics technologies



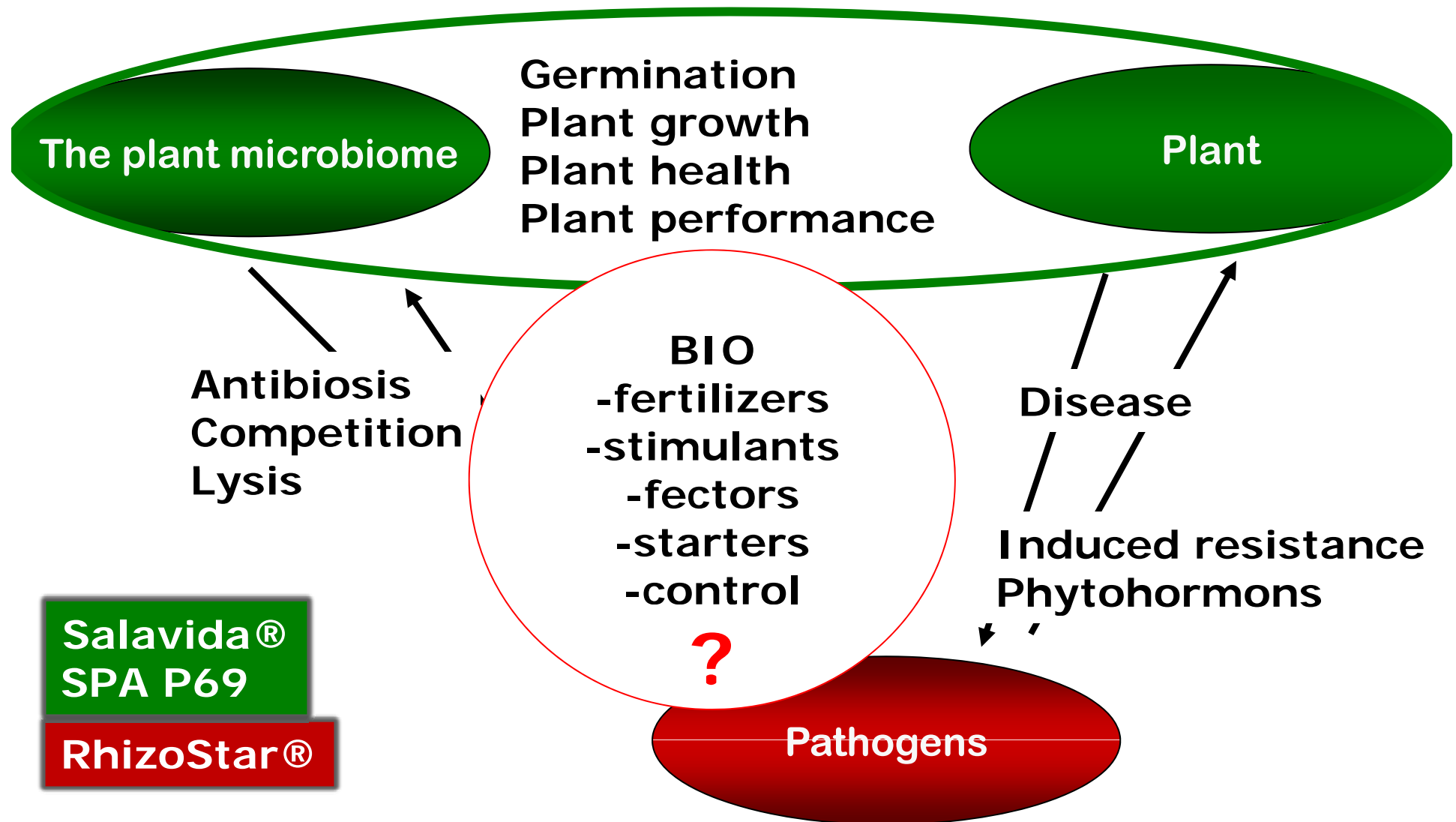
Gabriele Berg, TU Graz, Austria



Institut für Umweltbiotechnologie
Technische Universität Graz

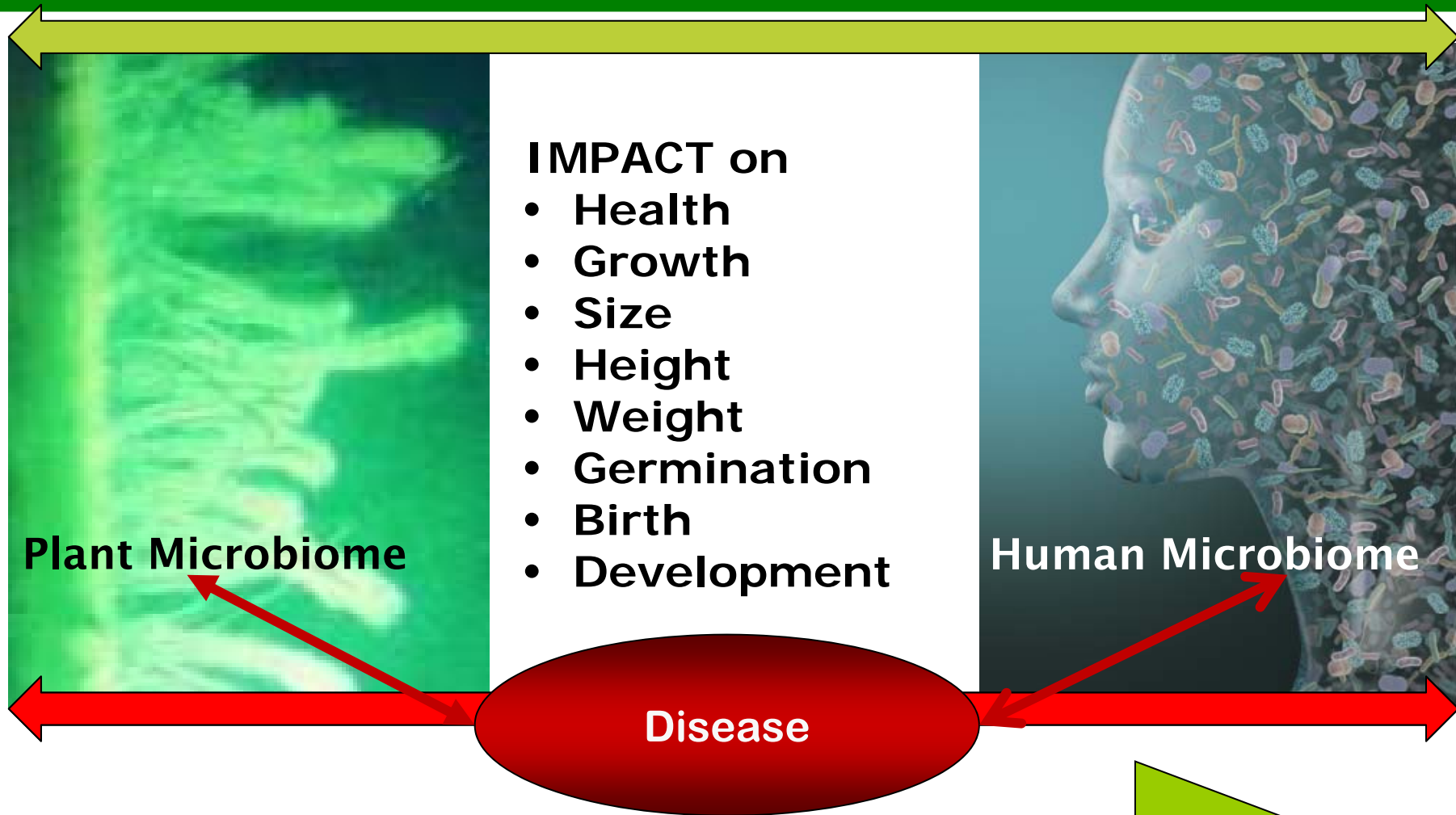


INTRODUCTION: the plant microbial network



[Berg et al. Microbiol Biotechnol 2009]

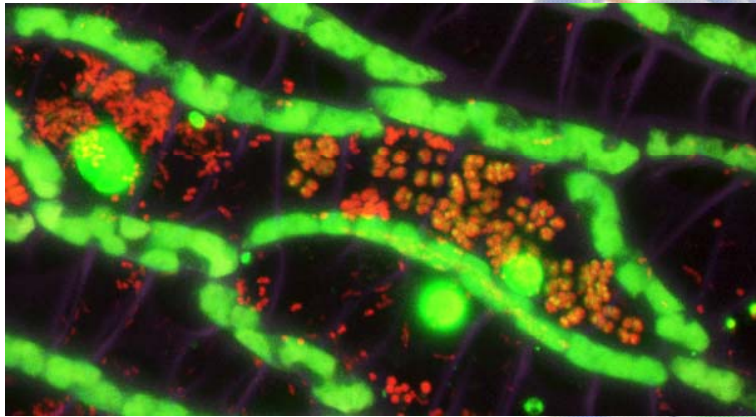
INTRODUCTION: Meta-organisms



H1: Microbiome shift is an important mode of action involved in plant diseases as well as biocontrol

INTRODUCTION: Methods and content

Advanced Biocontrol Technologies advanced by new tools



New techniques for sequencing

New bioinformatic tools

New techniques for microscopy



I. Detection of
new bio-
resources and



II. New
predictable
biocontrol



Optimization of
fermentation
and



III. Mode of
action/
reaction

H2: Novel mode of action can be detected using omics technologies

Assessment

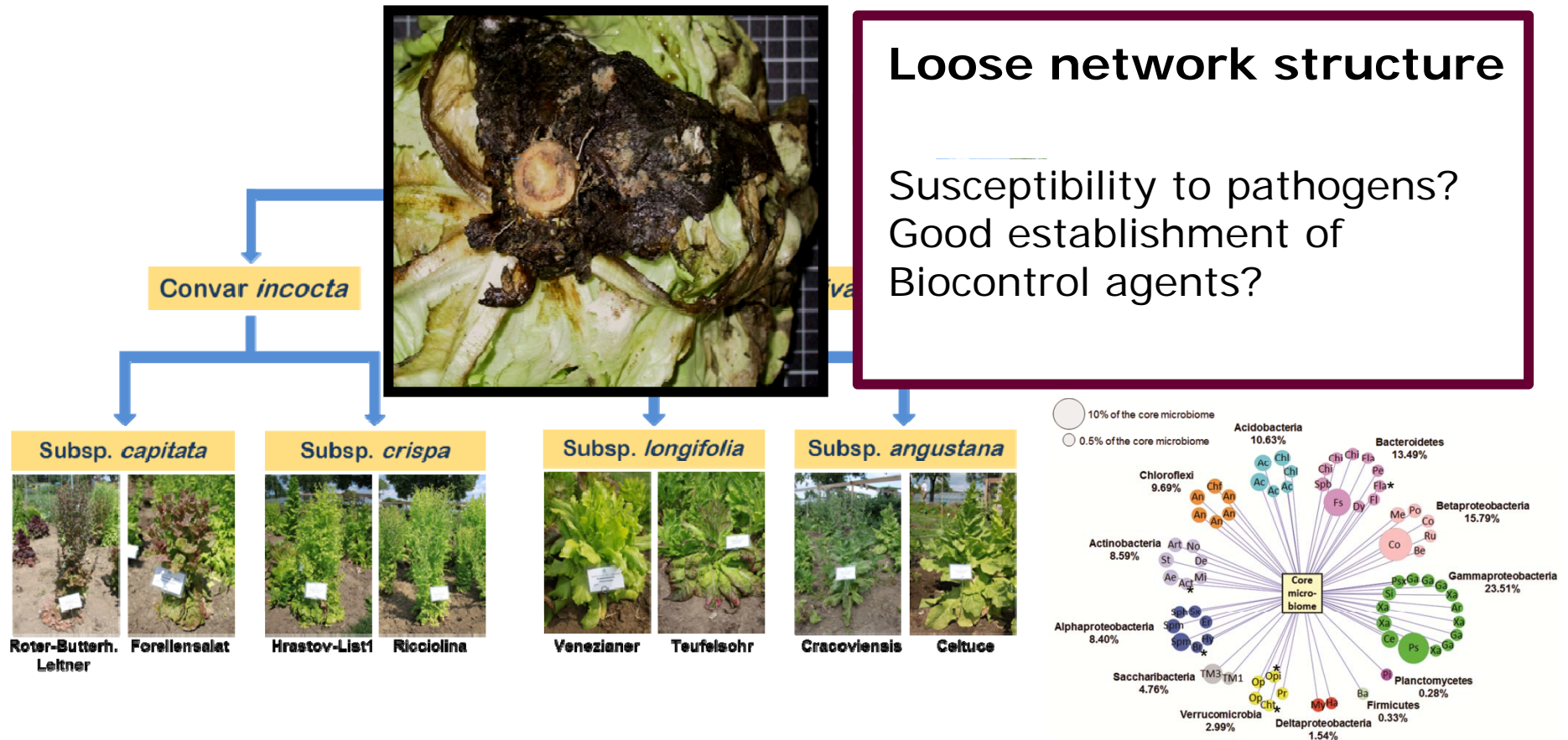
[Berg et al. Agronomy 2013]

I. The lettuce project



The Lettuce project (EU)
Armin Erlacher, Massimiliano Cardinale
Martin Grube (KFU Graz)

Lettuce: specificity and co-occurrence patterns



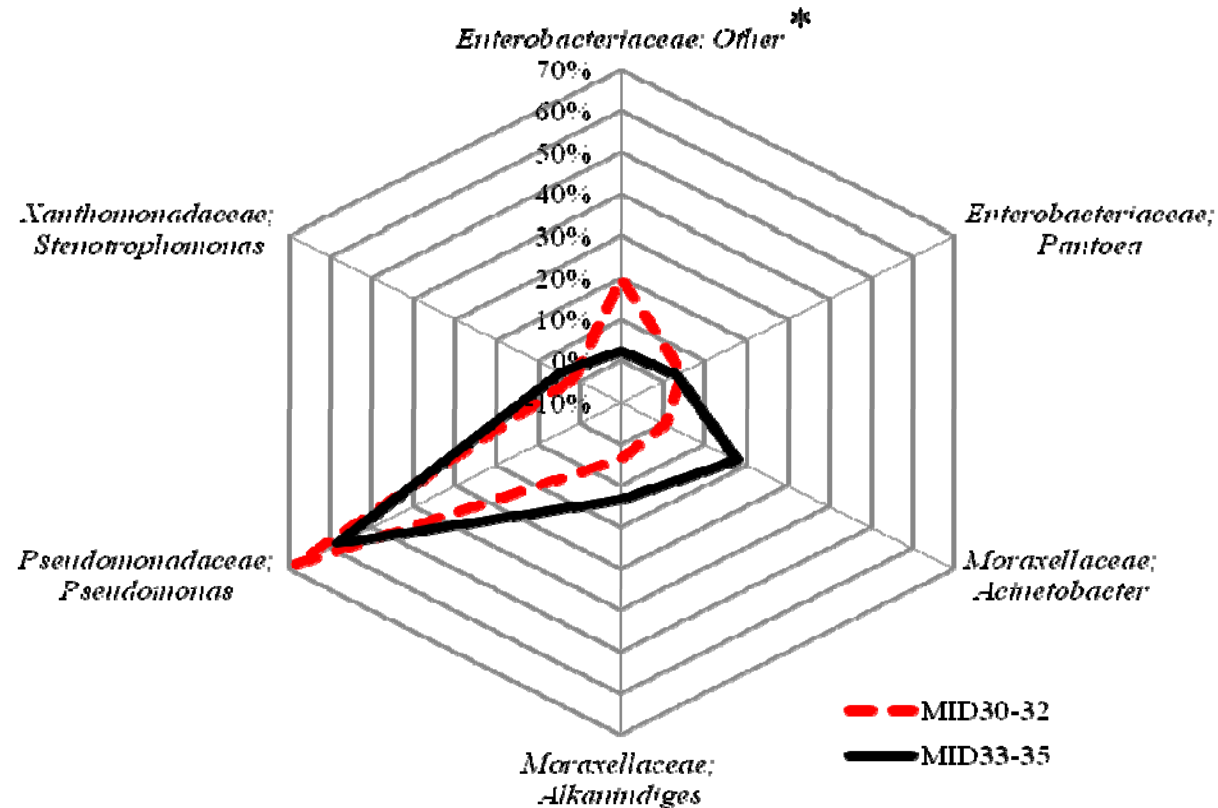
- significant differences at species and cultivar level
- 12.5% cultivar-specific bacteria; 49% core microbiome

Domestication lead to bacterial diversification in lettuce root system.

[Cardinale et al. Environ Microbiol. 2014]

Lettuce: the microbiome & disturbance

The intermediate disturbance hypothesis predicts large species numbers at intermediate levels of disturbance.



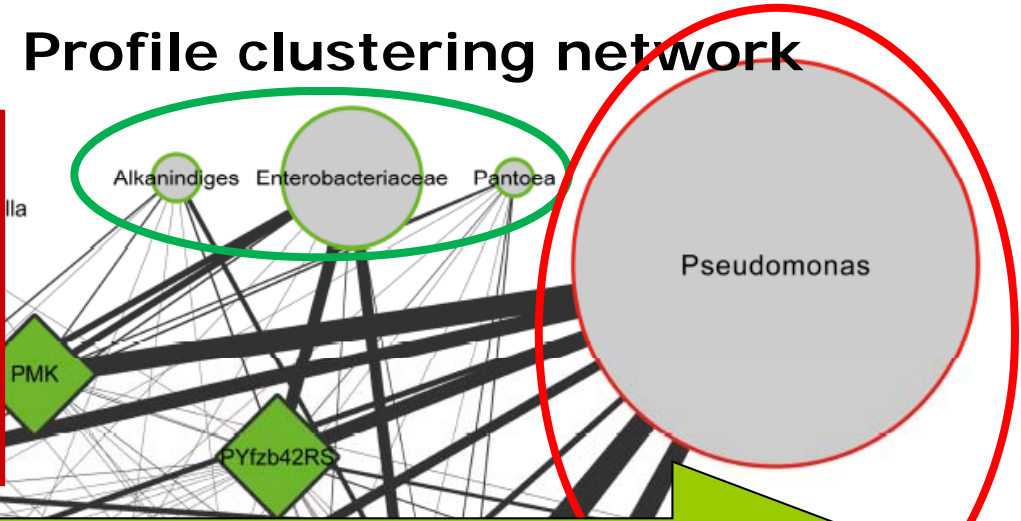
[Erlacher et al. PLoS One 2015]

All disturbing factors induced significant shifts in the bacterial community and increased species richness, such as *Enterobacter* in *Lactuca* and *Escherichia/Shigella* and *Pantoea* in *Eruca*.

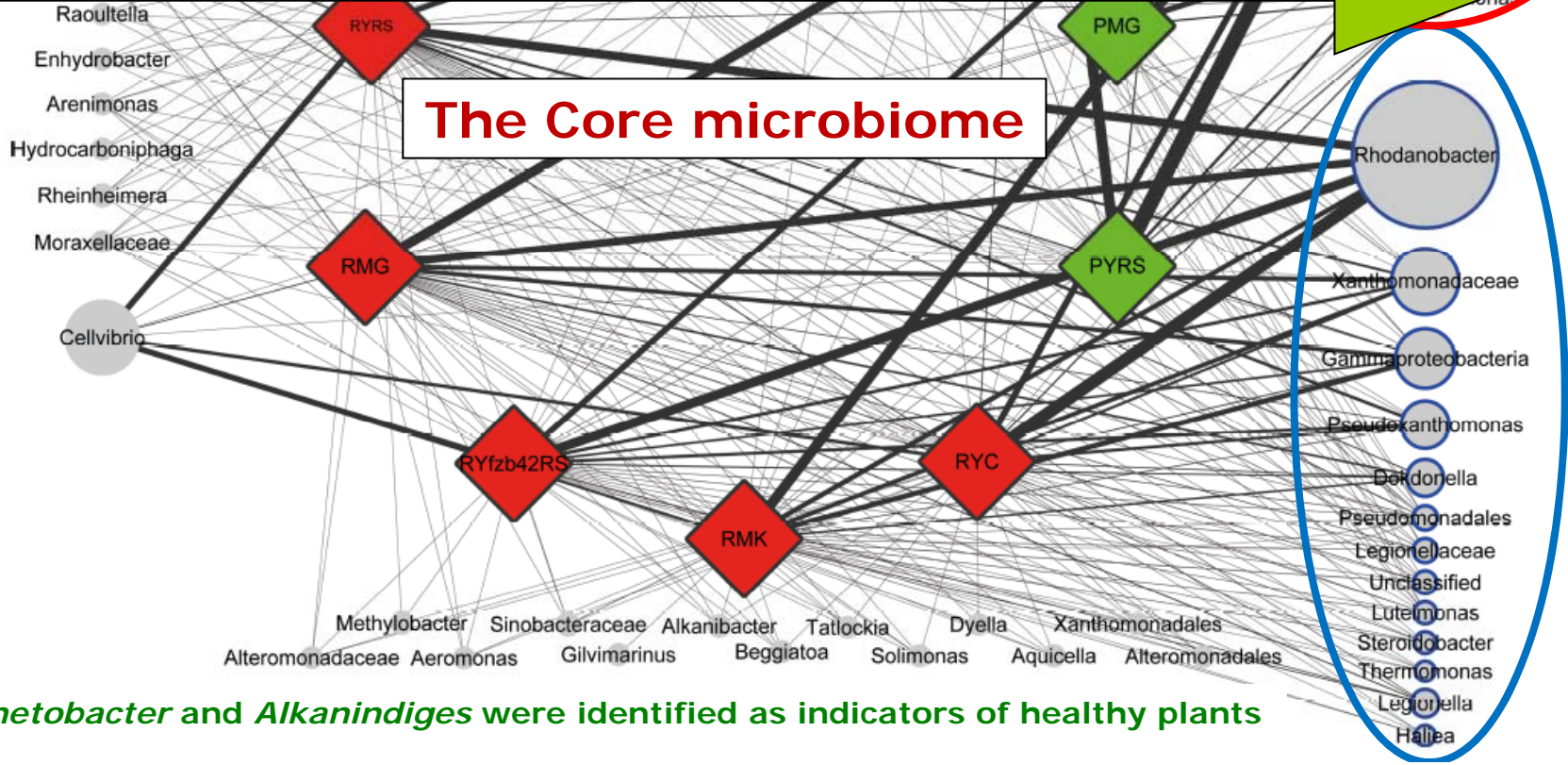
Treatment with biologicals: Profile clustering network

Abbreviations
 P – phyllosphere; R – rhizosphere
 Y – young; M – mature

Treatments
 RS – *R. solani*;
 C – untreated (control)
 FZB42RS – FZB42 and *R. solani* co-inoculation
 G – healthy; K – diseased.

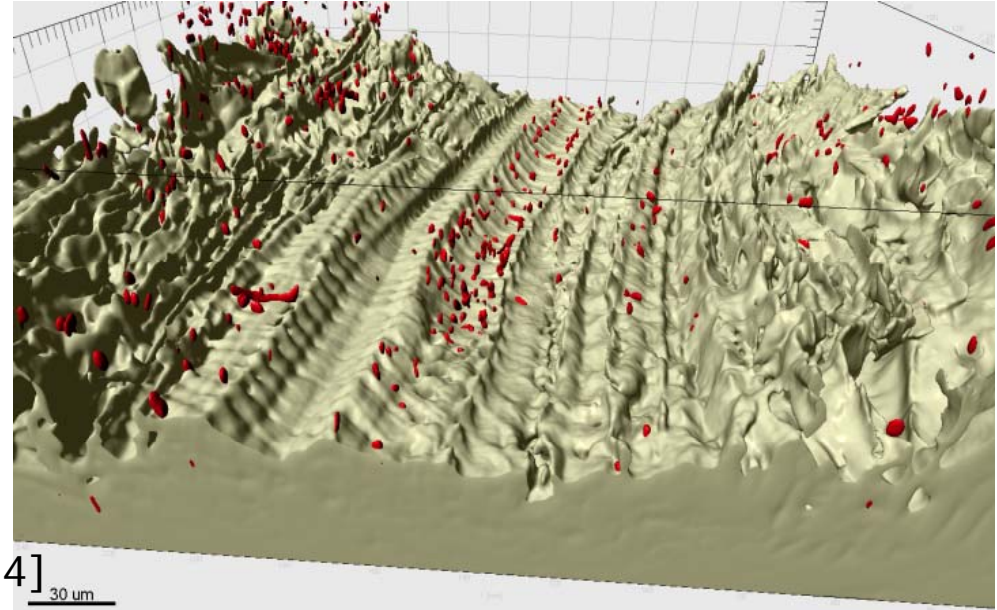
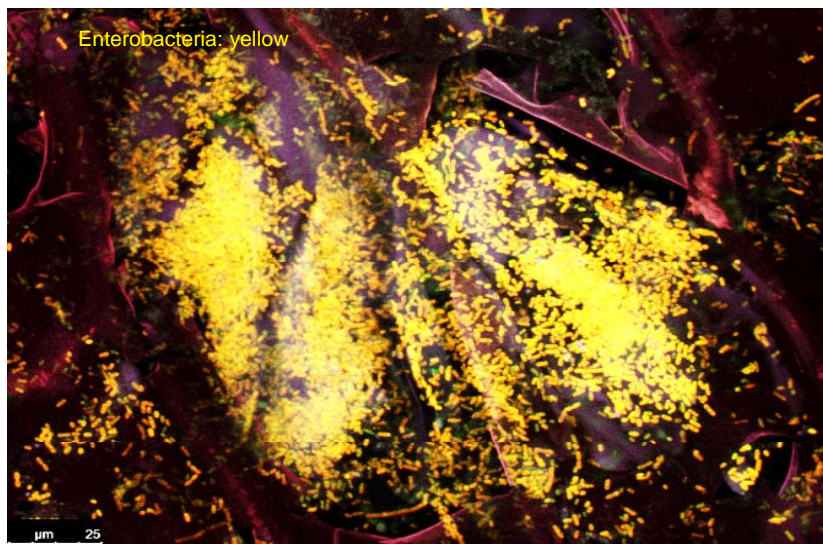
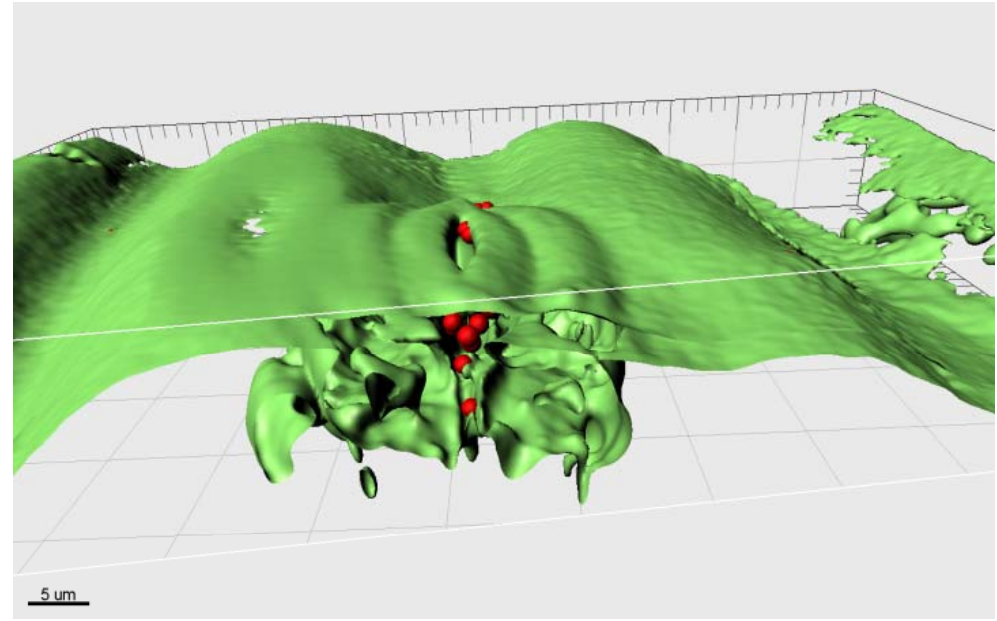


H1! Microbiome shift + enhanced diversity



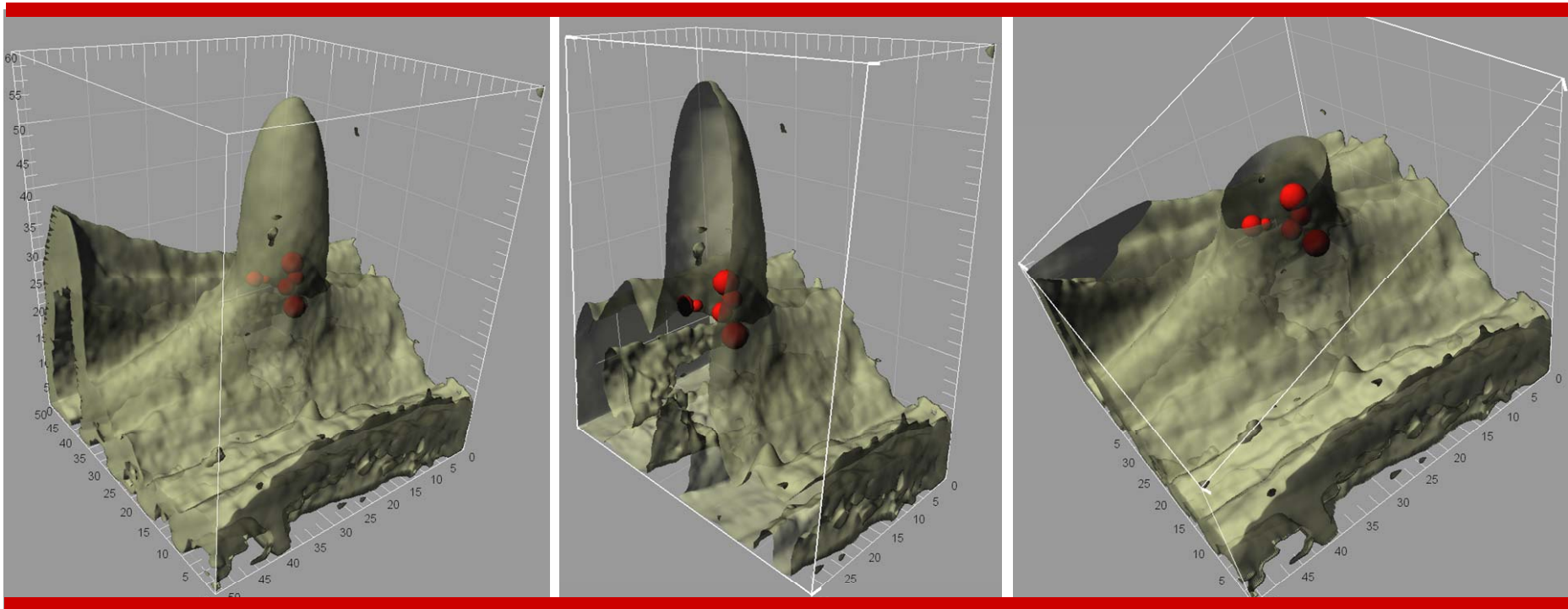
Acinetobacter and *Alkanindiges* were identified as indicators of healthy plants

Lettuce leaves: only internal colonization



[Erlacher et al. *Frontiers Microbiol.* 2014]

II. The *Stenotrophomonas* project



The *Stenotrophomonas* project (FWF)
Peyman Alavi, Christoph Schmidt
Henry Müller



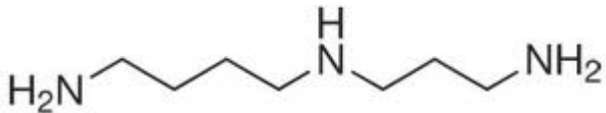
Stress protection: Mode of interaction

Root extracts

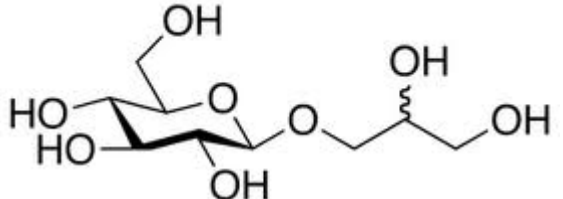
Verticillium stress

A-biotic stress

H2! Completely new mode of actions were identified



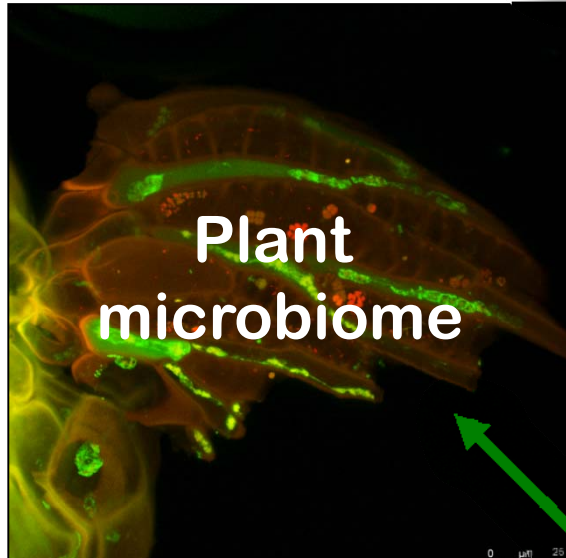
Spermidine



Glucosylglycerol

[Alavi *et al.* Frontiers Microbiol. 2013]

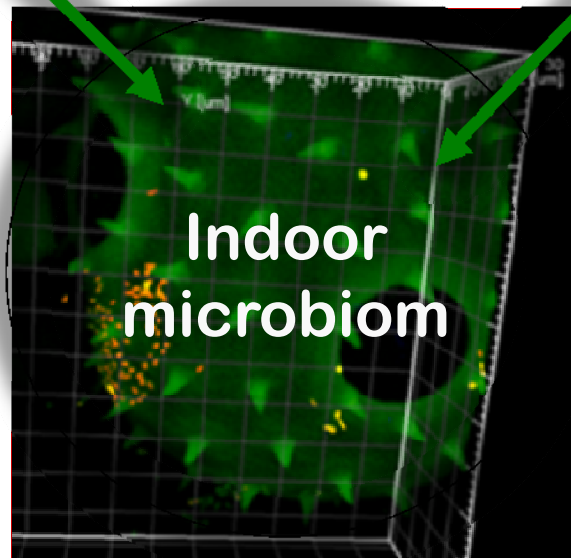
Interaction of microbiomes



[Davis et al. Nature 2014]

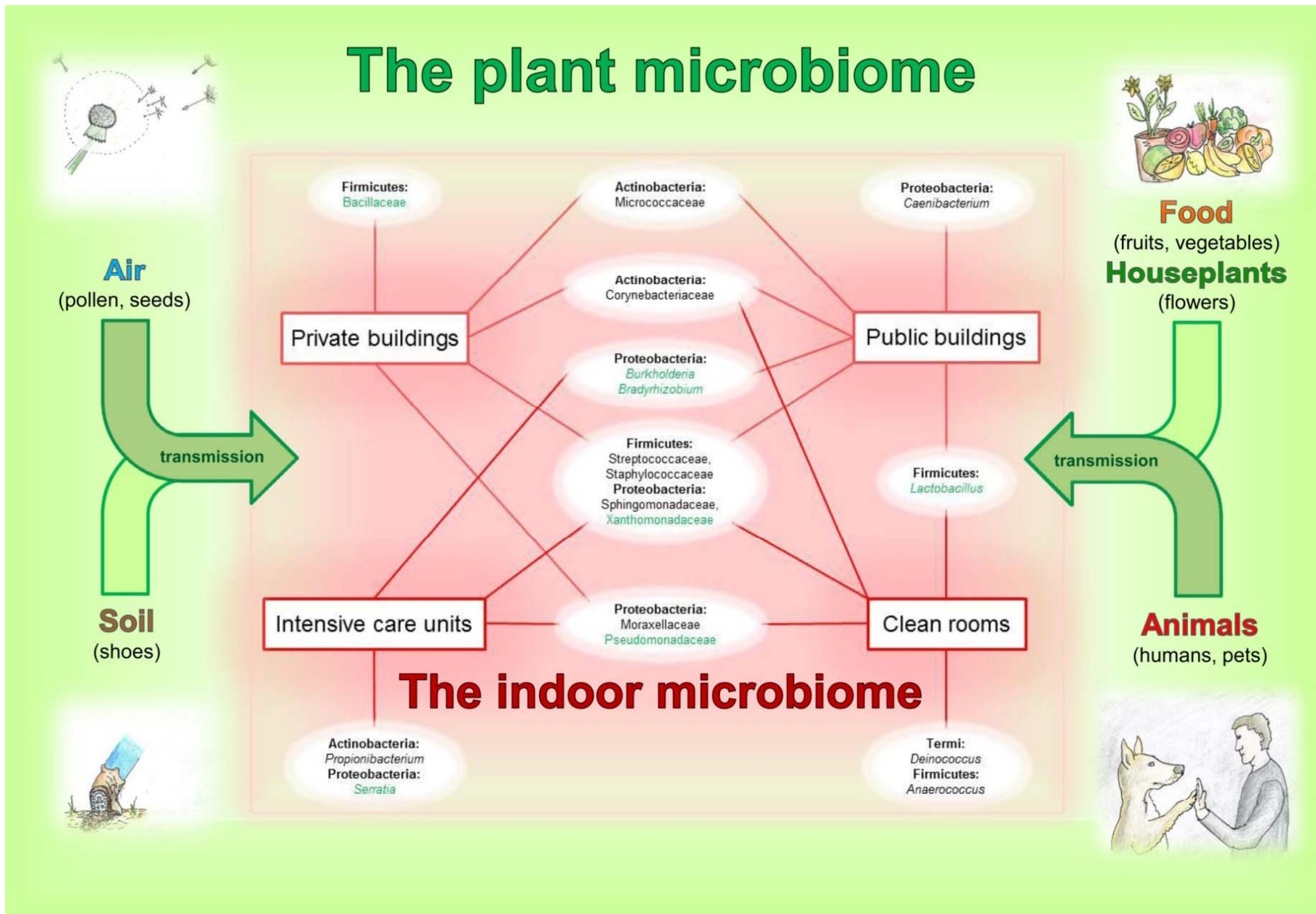


Role of the plant microbiome as source for beneficials?

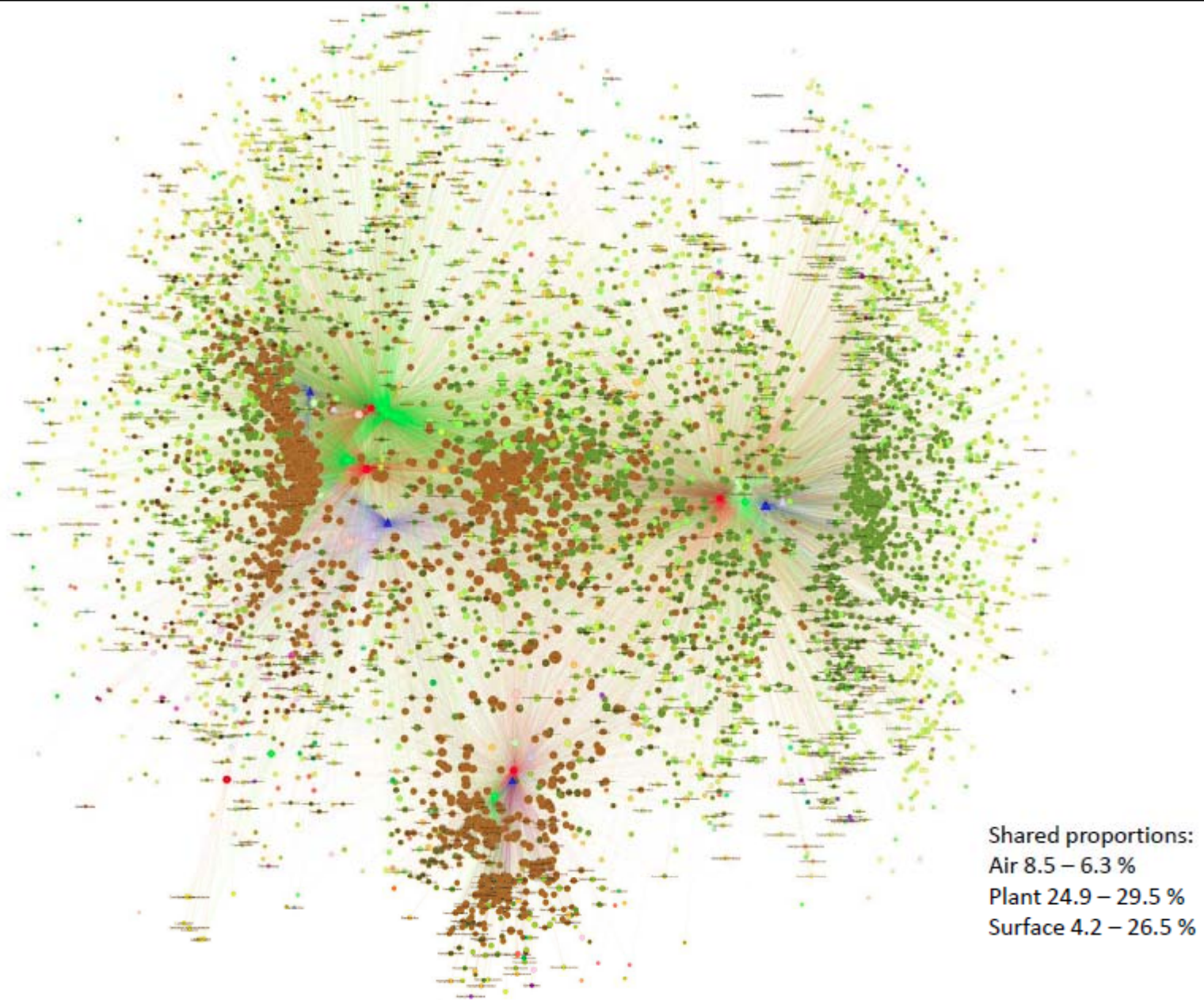


[Qian et al. Indoor Air 2012]

Predicted microbiome design/exchange



Plants are an important source for microbes



- **Microbiome shift is an important mode of action involved in plant diseases as well as biocontrol.**
- **Novel mode of action can be detected using omics technologies.**



Vision: Healty food for our health

OUTLOOK

The majority of microorganisms acts by several modes of actions.

The mode of action is influenced by environmental factors.

Novel technologies can help to detect novel mechanisms but this is often a long way and difficult to assess.....

Many facts are currently ignored:

- **Epigenetics**
- **Methylation of the genome**
- **Horizontal gene transfer**
- **Loss of microbial diversity**
- **Inter-kingdom interaction (Archaea!)**
- **Impact on other microbiomes (human gut, indoor)**
- **Impact on immune systems**

OUTLOOK



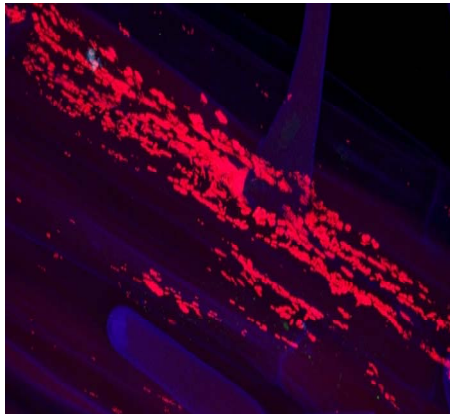
It is impossible to exclude (potential, further) pathogenicity of micro-organisms.

It is impossible to avoid any risk in life – a lot of knowledge and a careful (individual) evaluation is necessary.

A new evaluation approach is necessary.



Low risk products + active descision making



Stenotrophomonas SPA P69 - suicide vector at 37°C



Coniothy

Green
BIOLOGICALS

mode of action



Bacillus subtilis – long term use without problems