



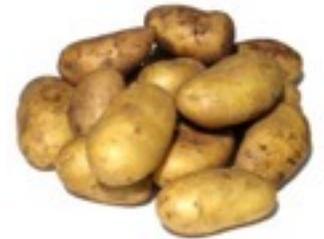
Plant Pathology Breakthroughs

Laura Grenville-Briggs Didymus
Professor of Integrated Plant Protection, SLU

Crop protection futures in agriculture
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Plant diseases hinder food security

- Plant diseases have economic, social & ecological implications
- Fungal and fungal-like plant diseases are major threats
- Over 175M tonnes of damage in top 5 food crops
 - approximately 30 % yield losses
- Halting just the major disease in each of the top five food crops could feed up to 4 billion *more* people per year



Major challenges and advances in Plant Pathology

Plant Pathology

Climate change and global trade

Disease management

Disease surveillance, detection and diagnosis

Precision agriculture

Plant growth and development

New approaches to exploit host genetics/resistance

Holobiont, microbiome and soil health research

New plant protection biologicals/chemicals

Exotic and re-emerging pathogens

Diagnostics

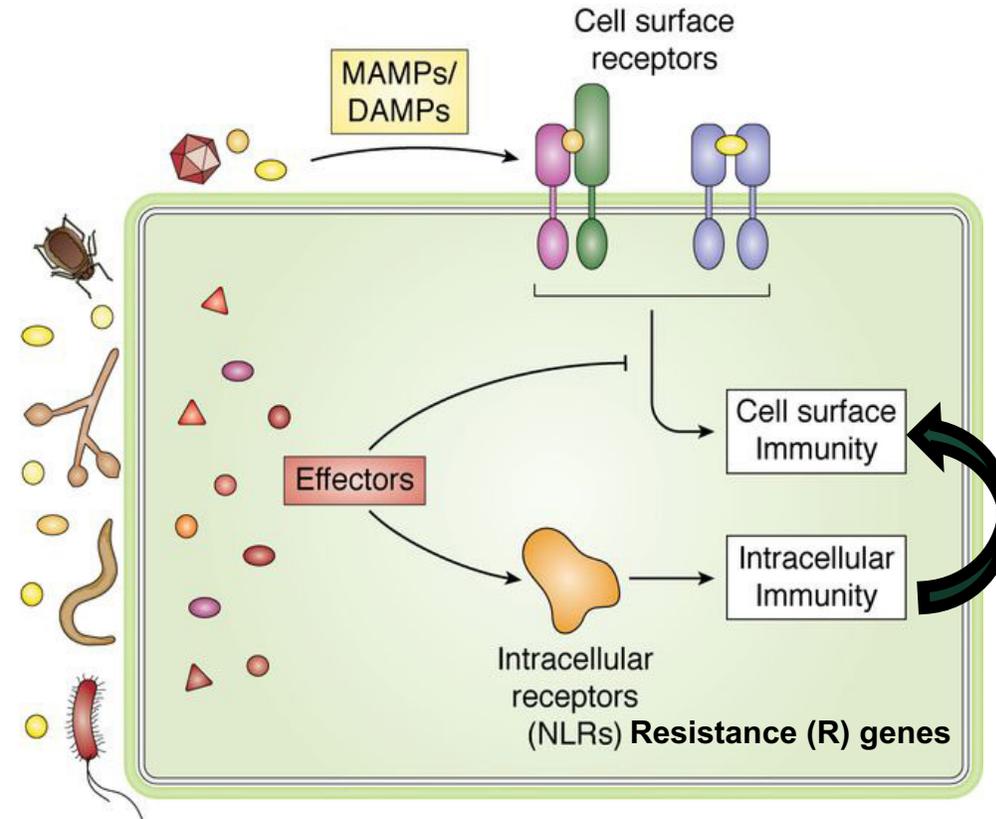
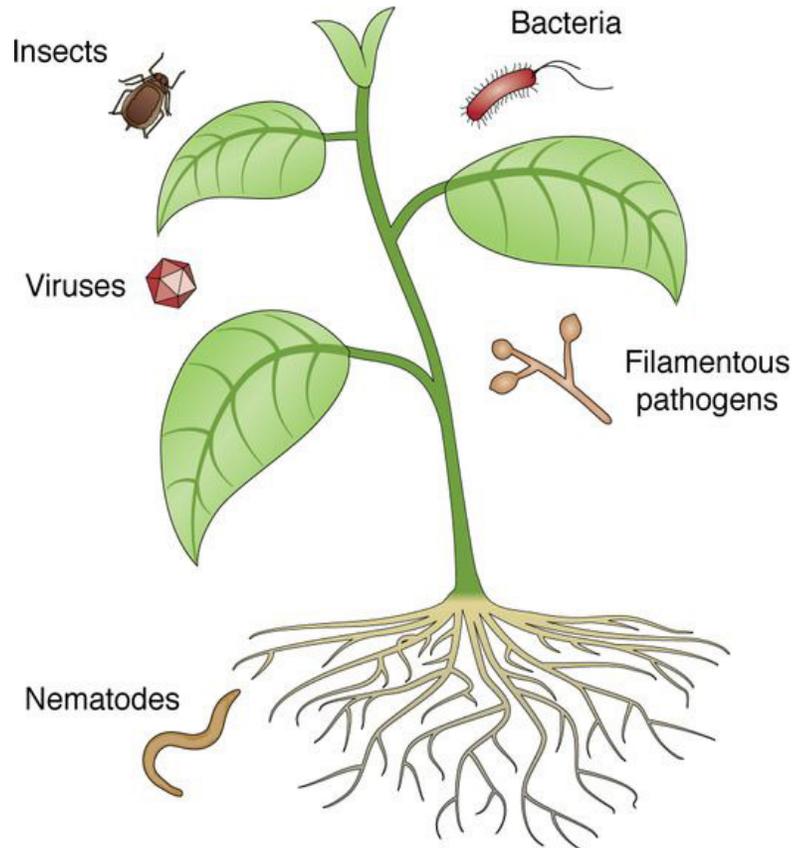
Detection beyond the border

Remote Sensing

Passive Surveillance

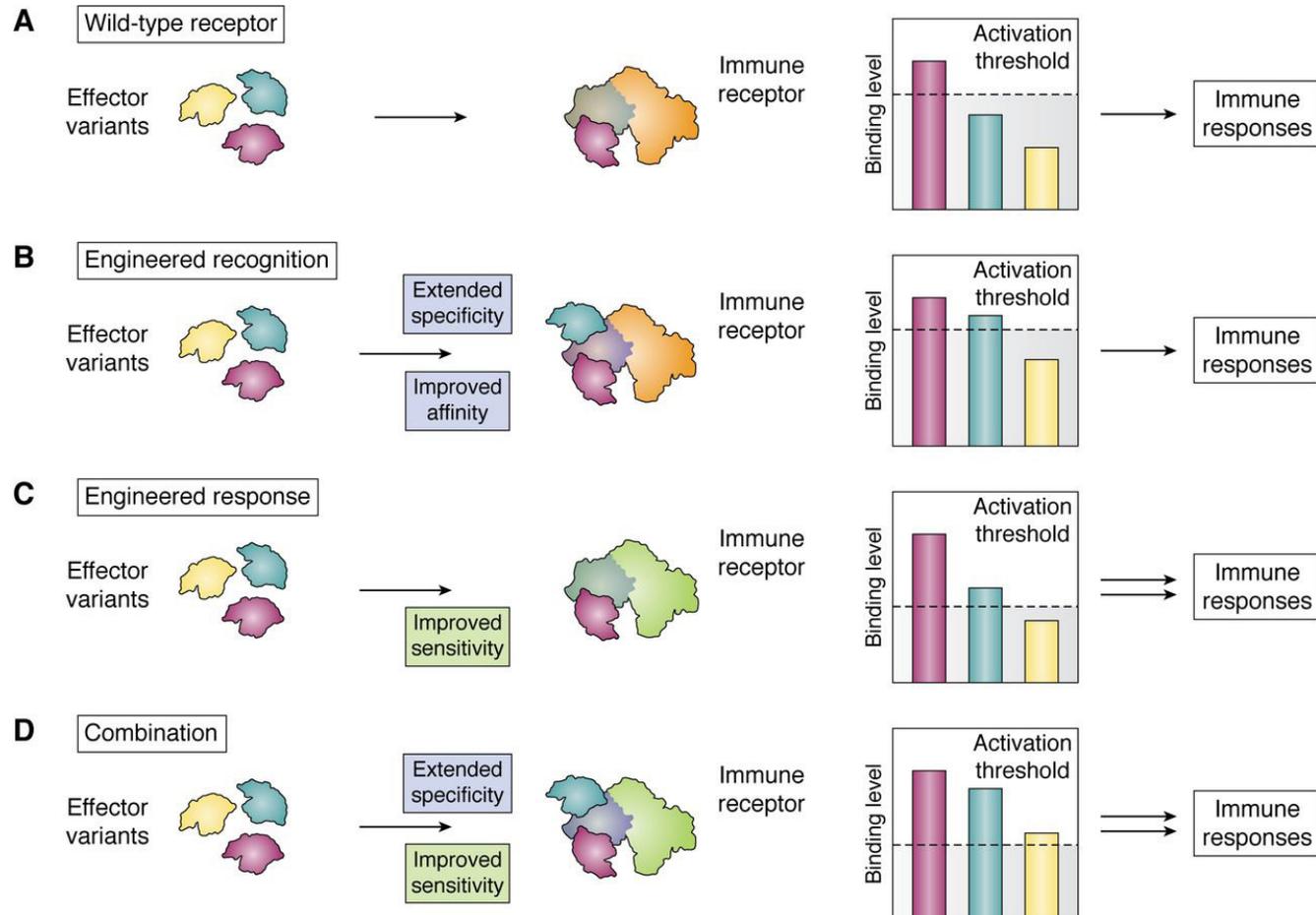
A new understanding of plant immunity

- Cell surface immunity acts as the primary defence mechanism against pathogens and commensal microbes



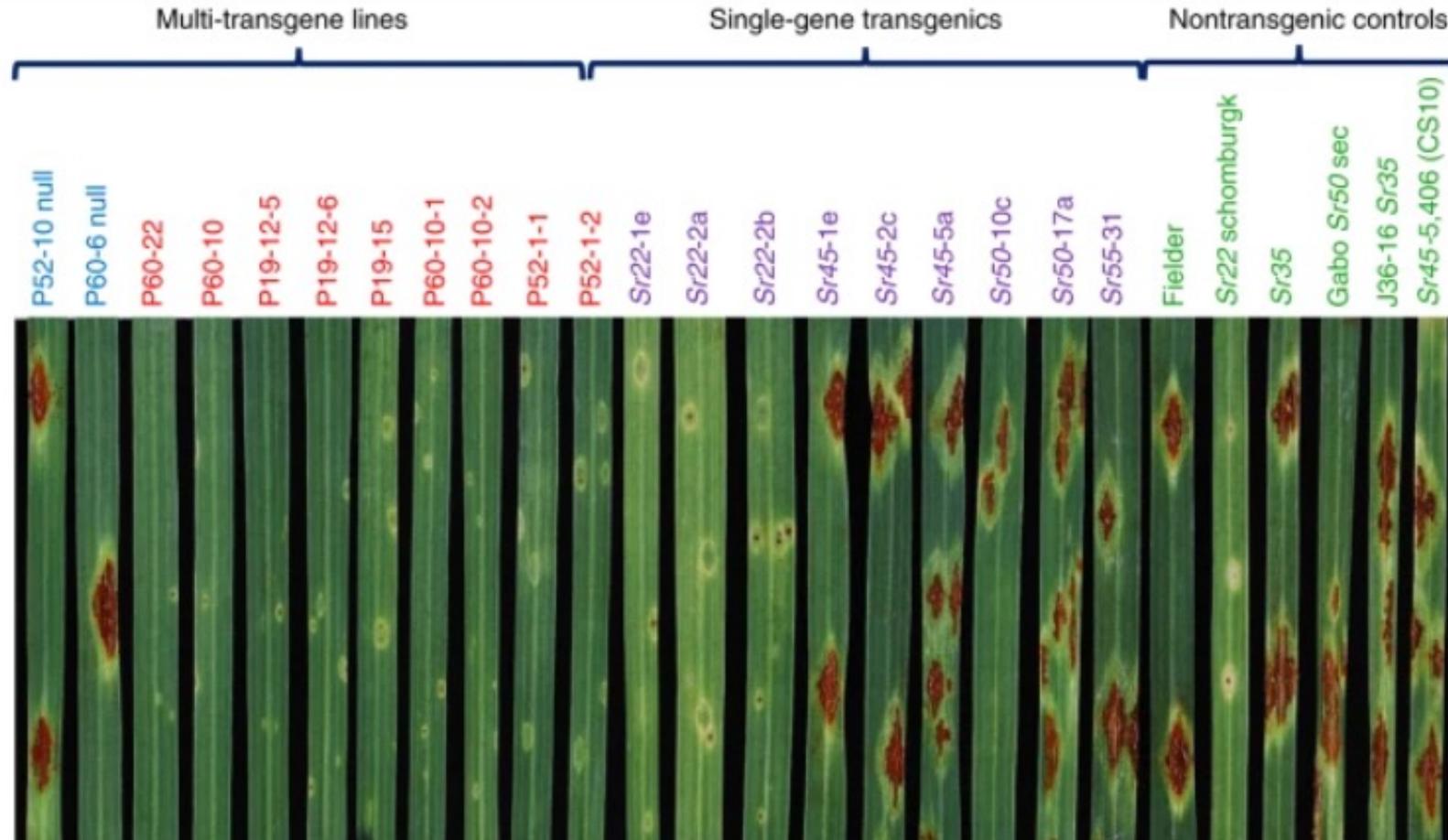
Breakthroughs in immunity against plant pathogens

Engineering more durable plant immunity (Genome editing)



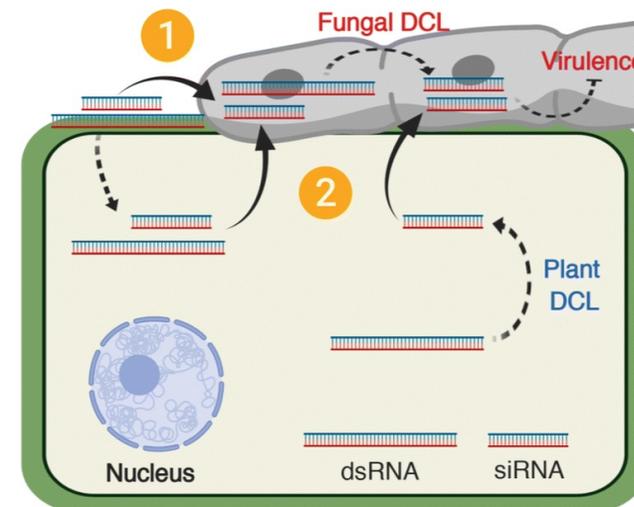
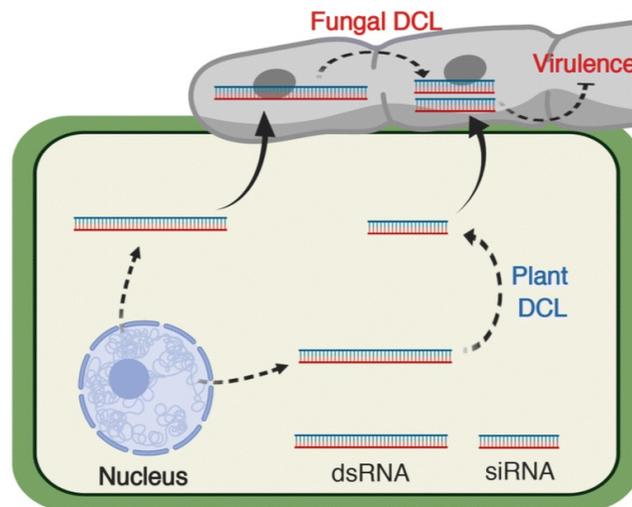
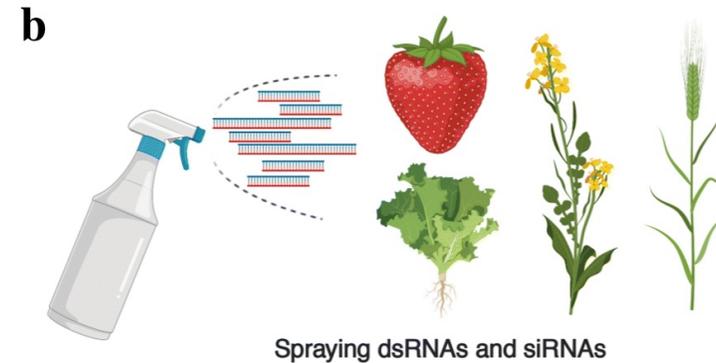
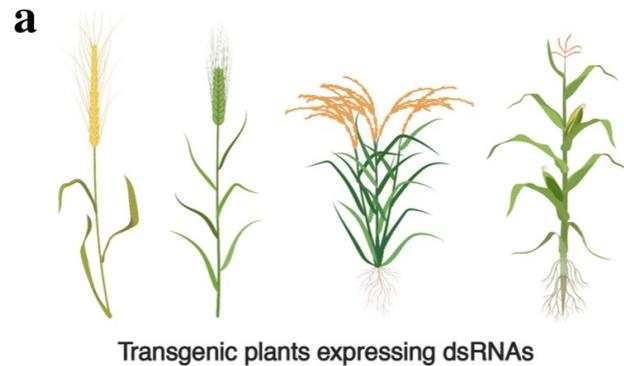
Breakthroughs in immunity against plant pathogens

Pyramiding of NLR resistance genes enhances genetic durability and provides physiologically stronger resistance



Breakthroughs in controlling plant pathogens

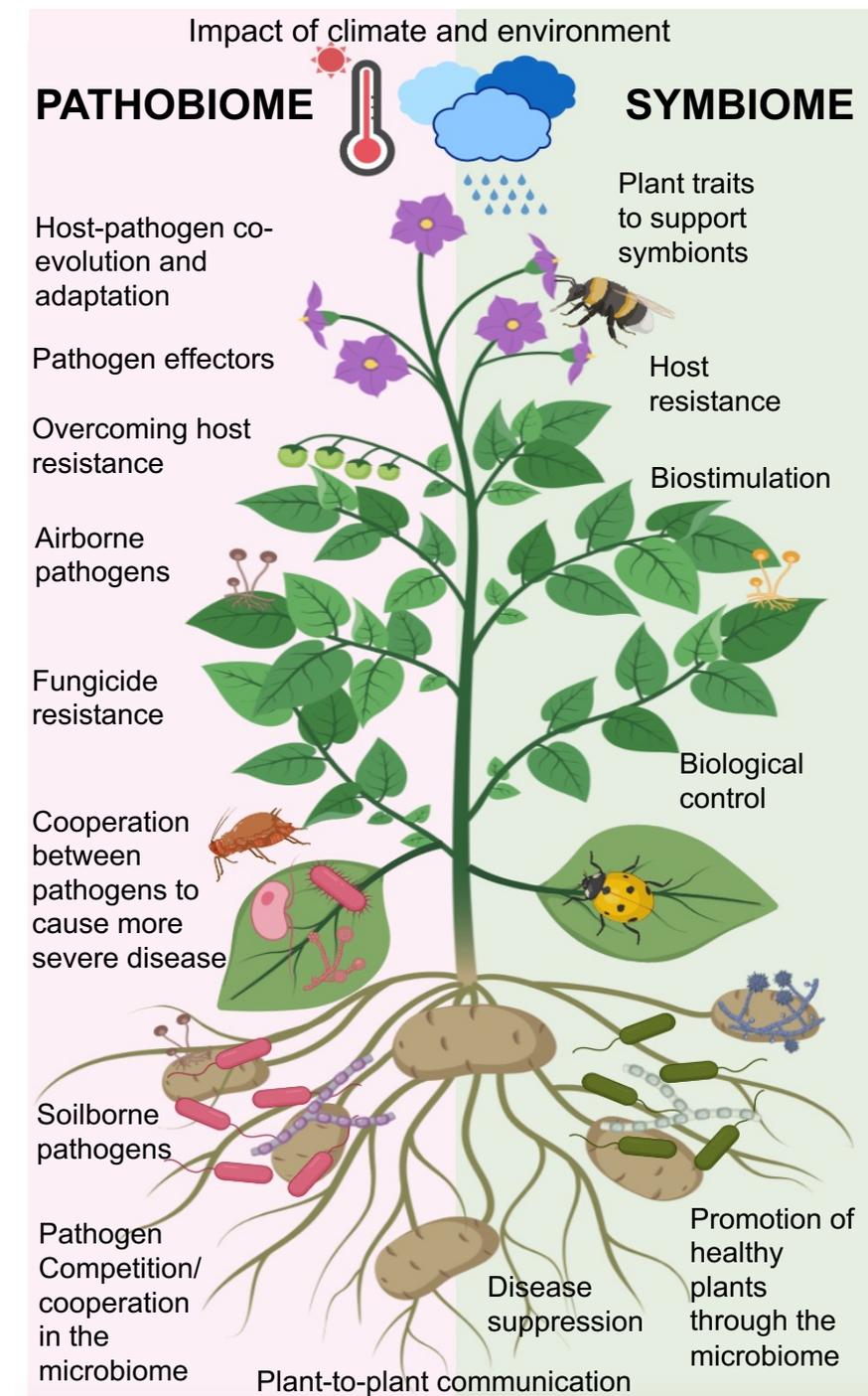
Host-induced or spray-induced gene silencing



Breakthroughs in understanding plant pathogens

Moving away from binary studies to a holobiont perspective on healthy plants

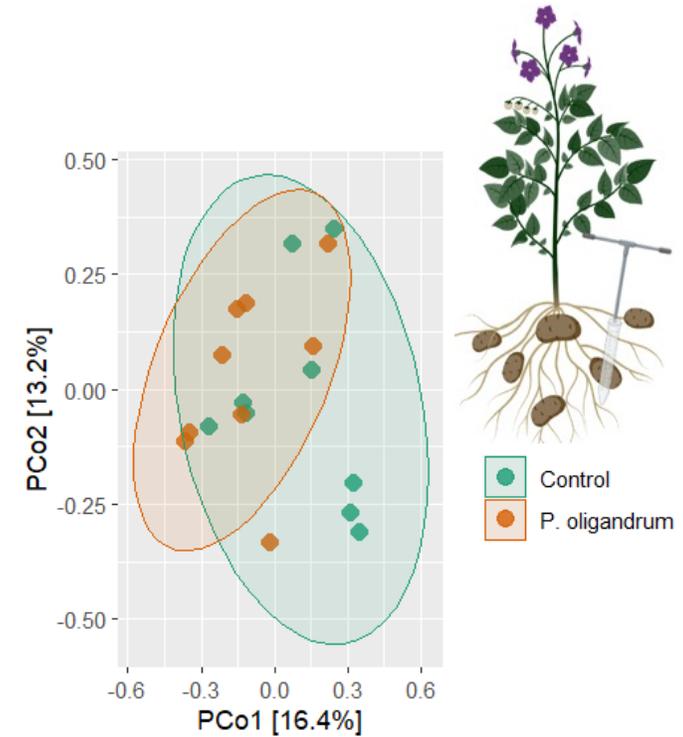
- Pathogens in a community context
 - Different pathogens cooperating/competing
- Biocontrol in a community context
 - BCA interactions within microbiomes
- Understanding and manipulating crops to better host beneficial microbes



Breakthroughs in biological control of plant diseases

Improved efficacy & environmental interactions- a key to better implementation of biocontrol?

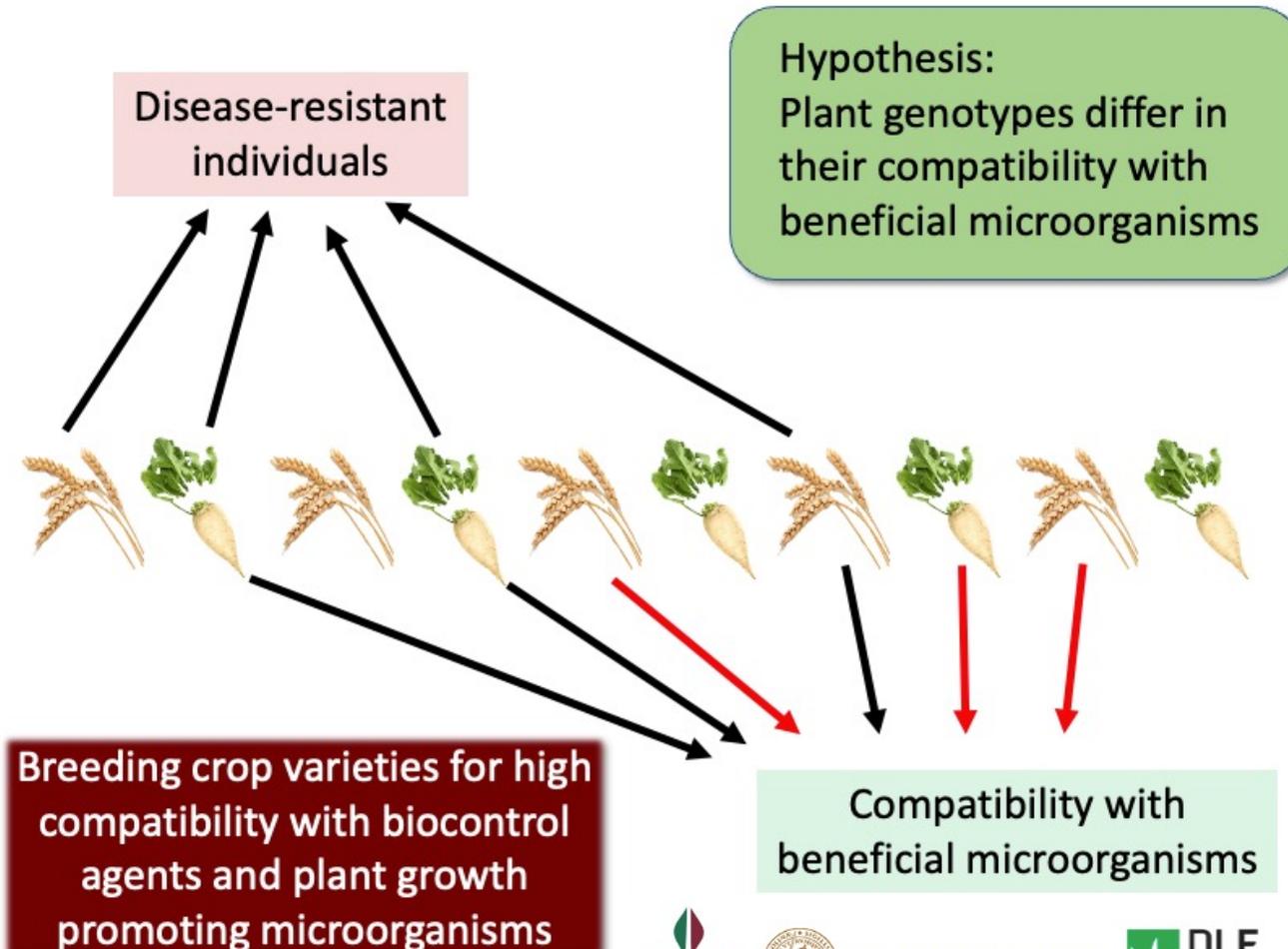
- Biocontrol is less reliable than synthetic pesticides
 - Survival in harsh environments
 - Endophytes may be better adapted to this
- Biocontrol agents and plant pathogens may affect and be affected by microbial communities
- Consortia- SynComs
 - Engineering of BCAs for better survival in microbiomes
 - Engineering of microbiomes for better biocontrol of plant diseases
- Legislation and registration
 - Needs to be faster and easier
 - Move away from the model for synthetic pesticides



The BCA *Pythium oligandrum* induces transient changes in the potato rhizosphere microbiome

Breakthroughs in biological control of plant diseases

Breeding for better hosting of microbial biocontrol agents



Biocontrol of plant diseases is often unreliable in the field

As well as environmental factors, plant genotype plays a role in the efficiency of biocontrol

We are identifying genes and markers for biocontrol compatibility for use in breeding programs

We hope this will result in more reliable & resilient biocontrol

Conclusions

- Advances in our understanding of plant immunity and new technologies provide the basis for the development of more durable resistance to plant diseases
- The study of molecular plant-microbe interactions is moving from a binary focus to an ecological perspective of the plant as a holobiont
- Knowledge is being gathered on the interactions between biocontrol agents and microbial communities for future engineering efforts
- Plant breeding is beginning to include strategies for breeding for beneficial microbes and a healthy microbiome
- We need support for long-term (field) studies to realise all of these breakthroughs in practical applications