Combining antagonistic bacteria with copper to control late blight disease in potato plants

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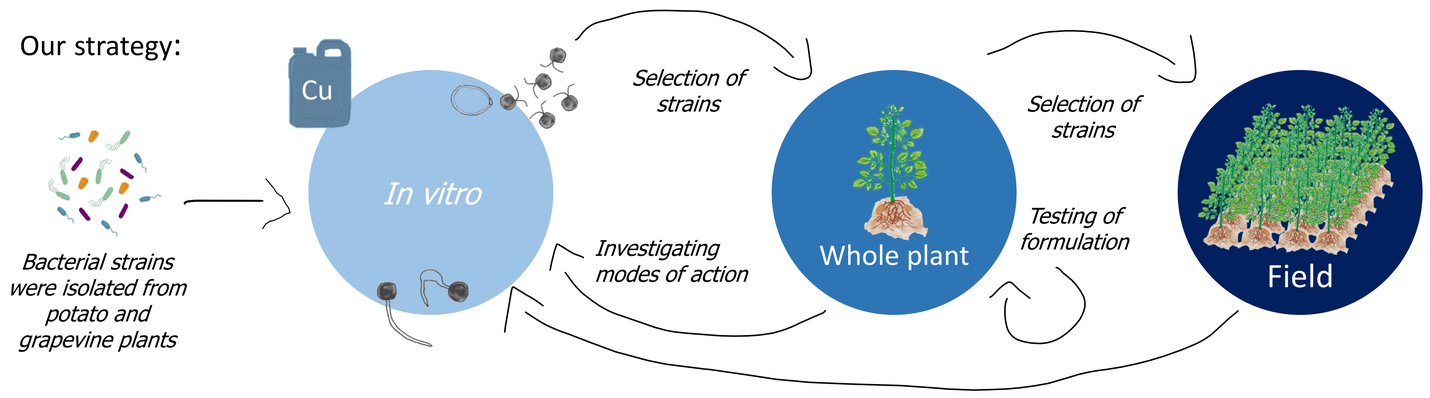
Phytophthora infestans, causal agent of potato late blight and the most devastating pathogen of this crop, often requires large amounts of fungicides to be controlled. In Switzerland, copper-based products are allowed in organic potato production, presenting a toxicological danger for non-target organisms. This project aims at reducing the use of these products by combining antagonistic bacteria with reduced amounts of copper.

Our strategy:



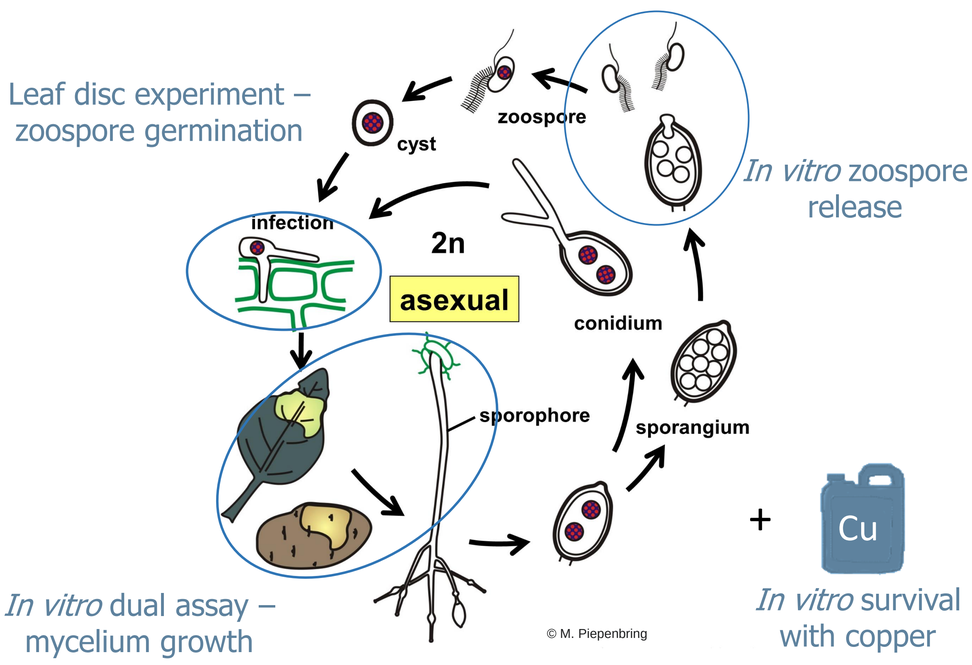
Bacterial strains were isolated from potato and grapevine plants

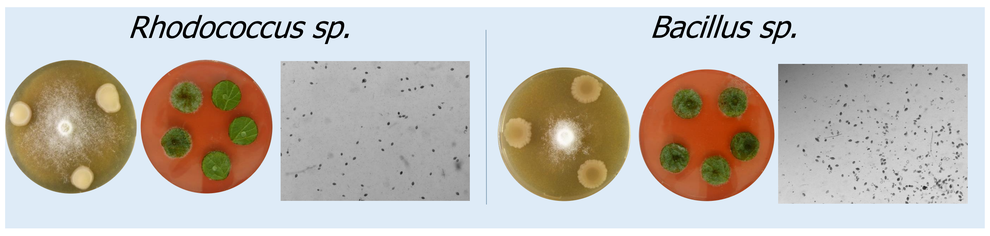
Bacteria appear as promising biocontrol agents. Indeed, they can act on different levels to prevent a pathogen from infecting a plant:

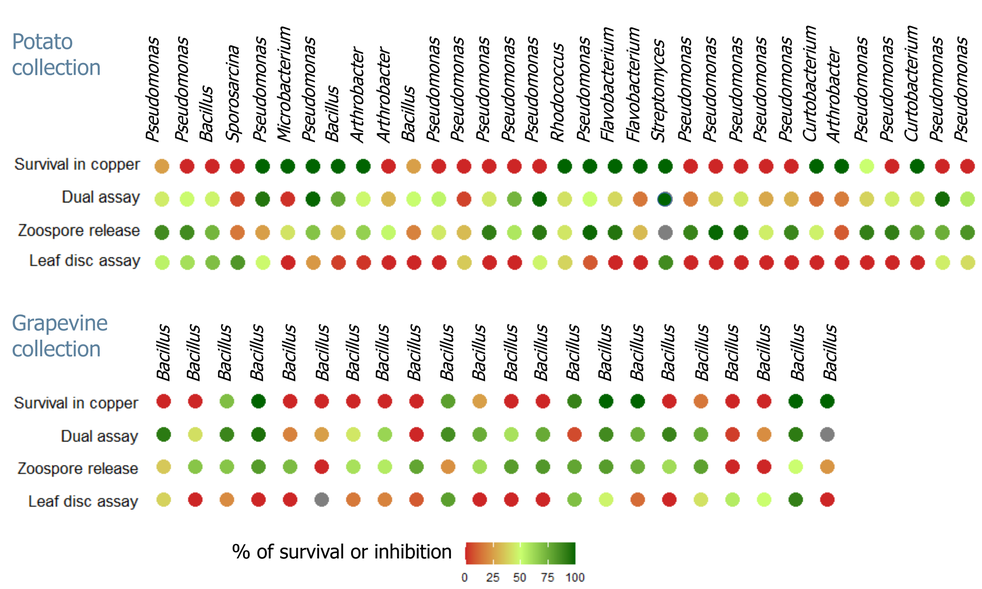
- Direct inhibition of the pathogen through the production of active compounds
- Competition for nutriments
- Induced resistance of the plant

A first selection

Over 200 bacterial strains belonging to different genera were tested. *In vitro* tests were carried out in minimal medium to mimic the naturally nutrient-poor conditions encountered by bacteria on plant leaves. Different life stages of *P. infestans* were targeted to assess the direct inhibitory potential of the strains. The strains' ability to survive with copper was considered as a main selection criterium.



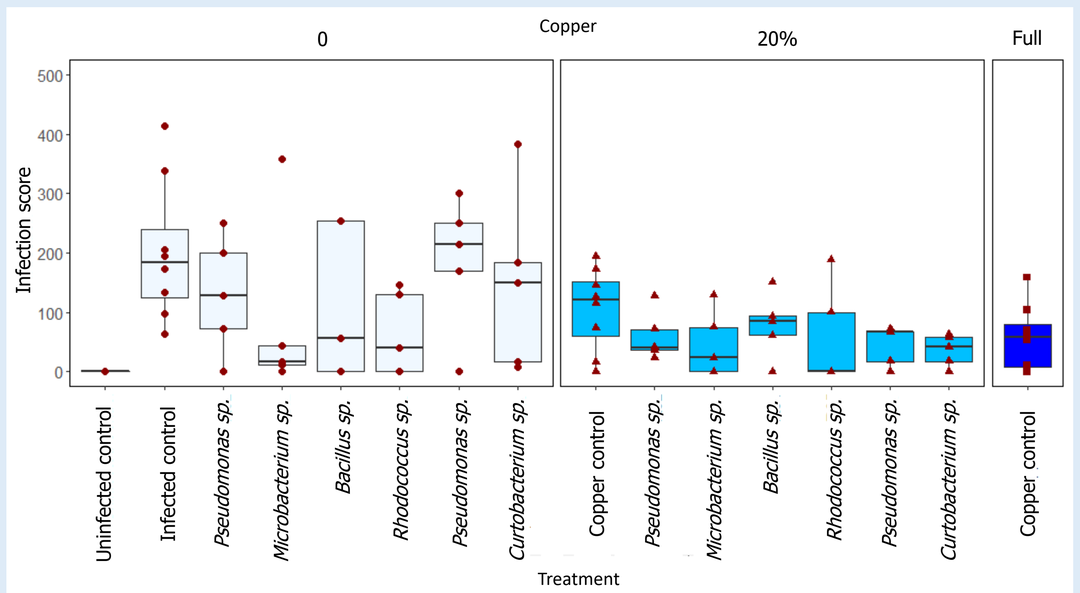




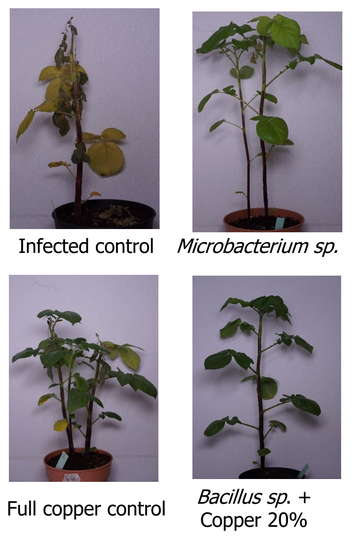
- Lots of strains could survive with copper
- Selection of different genera and not only *Pseudomonas* and *Bacillus*

Whole plant assay

Greenhouse plants (Bintje) were sprayed with bacterial suspensions with or without copper, and infected 2 days post inoculation.



Infection score of the whole plants 7 days post infection. The score was determined with a visual assessment of the symptoms severity and the percentage of infected leaves.

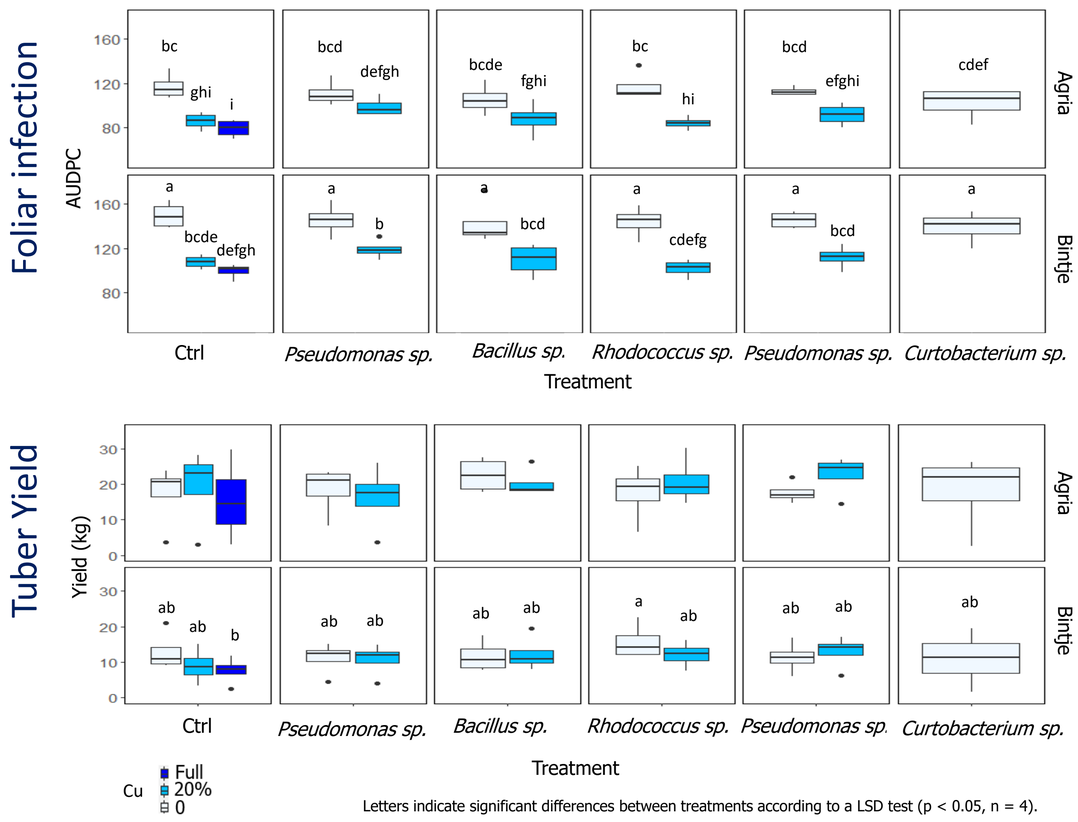


- High variability, especially without copper
- Effect of the strains and of copper on the disease development
- No significant effect between the different concentrations of copper
- Different genera showing promising results

Preliminary results tend to show that even a lower copper dose might be enough to confer a protection on greenhouse plants against *P. infestans*.

Field trial

The best candidate strains were tested in a field trial in Zürich. Bacterial suspensions alone or mixed with copper (20 % dose) were sprayed according to the Swiss DSS BioPhytoPRE.



Letters indicate significant differences between treatments according to a LSD test ($p < 0.05$, $n = 4$).

- Difficult season (2021) – very humid
- Effect of copper on foliar infection
- No significant effect of the treatments/ copper on the tuber yield
- No effect of the treatments/ copper on the tuber infection (data not shown)
- No phytotoxicity of our treatments

Despite the difficult field season, the obtained results, especially under greenhouse conditions, are promising. Furthermore, the large diversity of the selected bacterial strains confers new opportunities in the fight against *P. infestans*. Nonetheless, some improvement could be done regarding the application of the treatments.

Current focus:

- Bacterial **consortia**
- **Formulations** allowing a better spreading and survival of the strains

Partner: Agroscope

Funding: Schweizerische Eidgenossenschaft, Confédération suisse, Confederazione Svizzera, Confederaziun svizra – Office fédéral de l'agriculture OFAG