Working towards the use of integrated pest management (IPM) of early blight in potato in south Sweden

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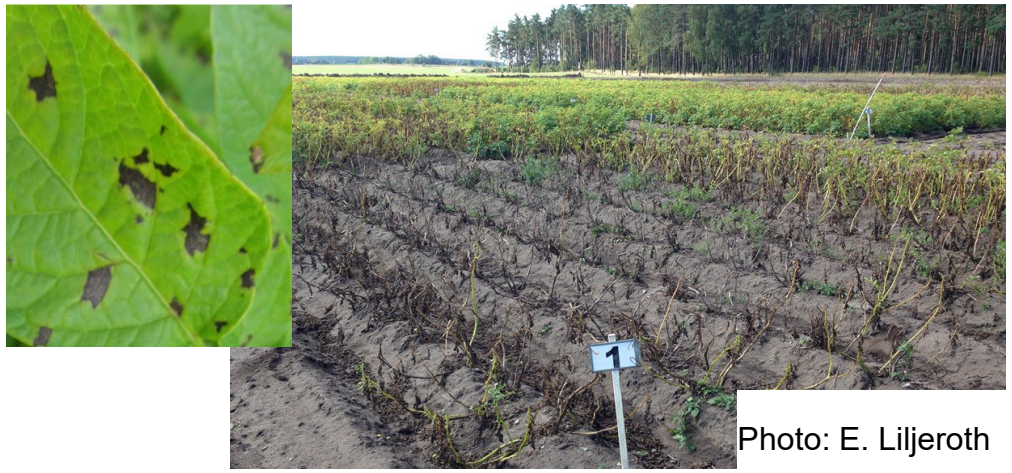

Photo: E. Liljeroth

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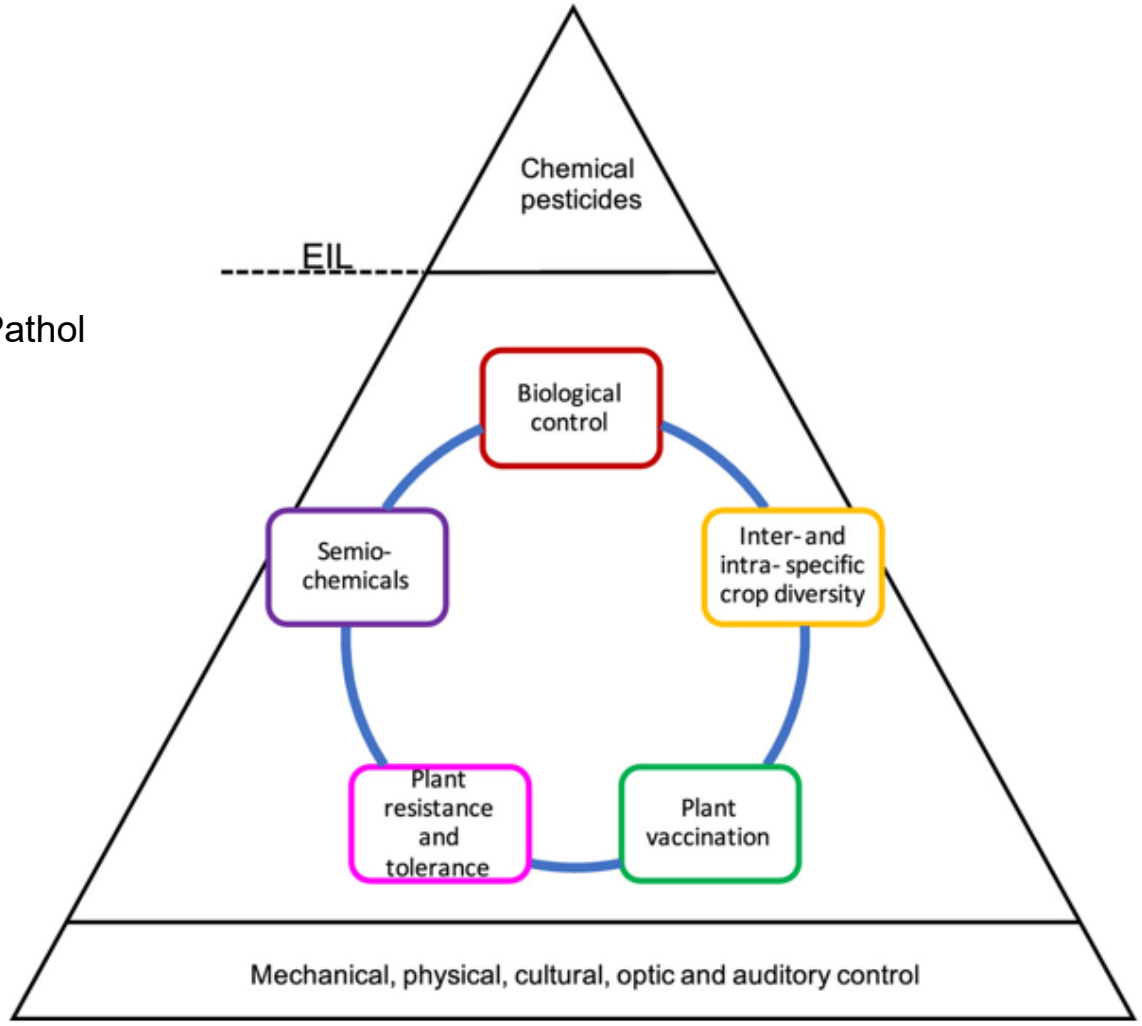
Potato early blight in south Sweden

Alternaria solani increased in south Sweden ca 10 years ago, at least partly caused by resistance development to fungicides

Edin et al. 2019, Eur J Plant Pathol; Mostafanezhad et al. 2022 Eur J Plant Pathol

Currently, newly introduced fungicides are effective, but for how long?

Integrated pest management (IPM) is a good way to reduce the use of fungicides and thereby mitigate the selective force to evolve resistance in the pathogen.



Karlsson Green et al. 2020; Evol Appl

IPM not well implemented for early blight

To increase the use of IPM it is important to gain knowledge about a broad range of factors, e.g. pathogen ecology, and how IPM control strategies can reduce the disease.

Also possible that IPM can contribute to mitigate resistance development to fungicides – but not so much investigated

Ongoing studies with the aim to increase IPM and understand how IPM can be used to mitigate fungicide resistance development

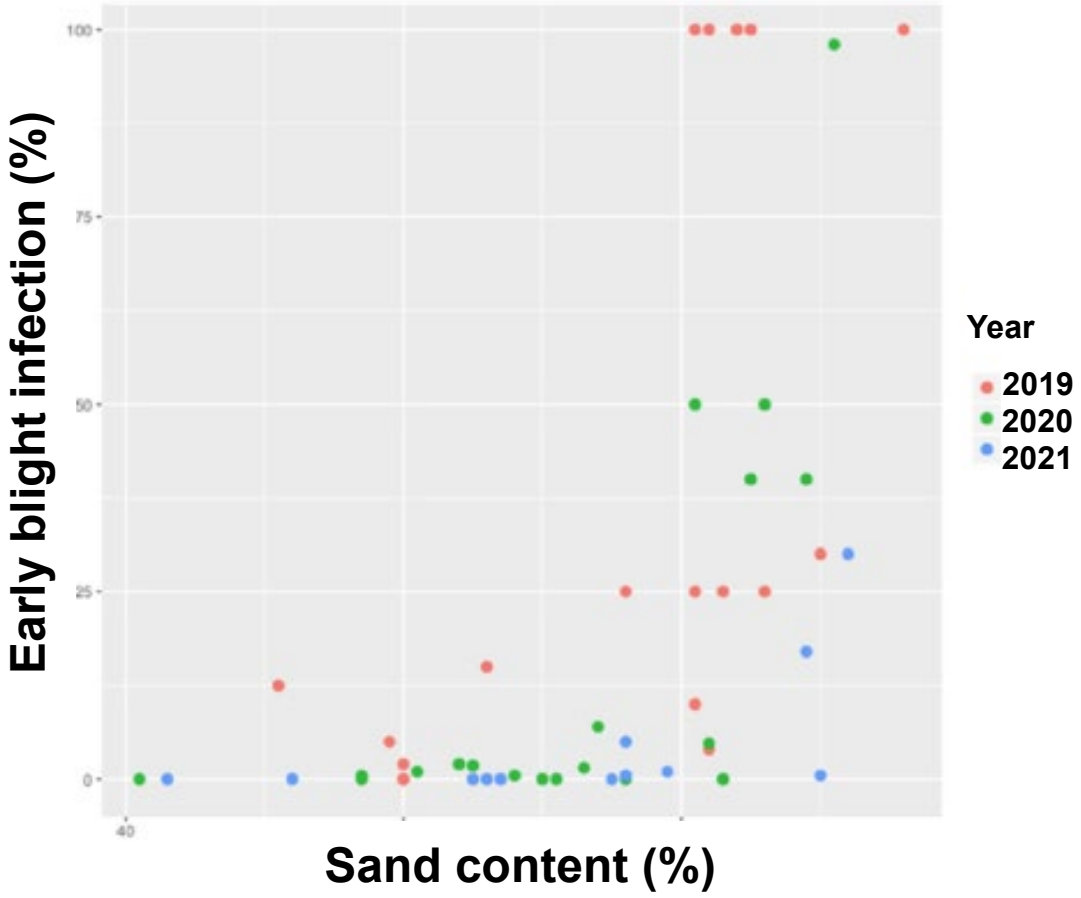
Ongoing studies – learning more about what influences *A. solani*

In a recent study of 52 farms, we found more disease in sandy soils in starch potato → recommendation of treatment adapted to soil type.

Stridh et al. 2023, Potato Res

Linnea Stridh

Erland Liljeroth



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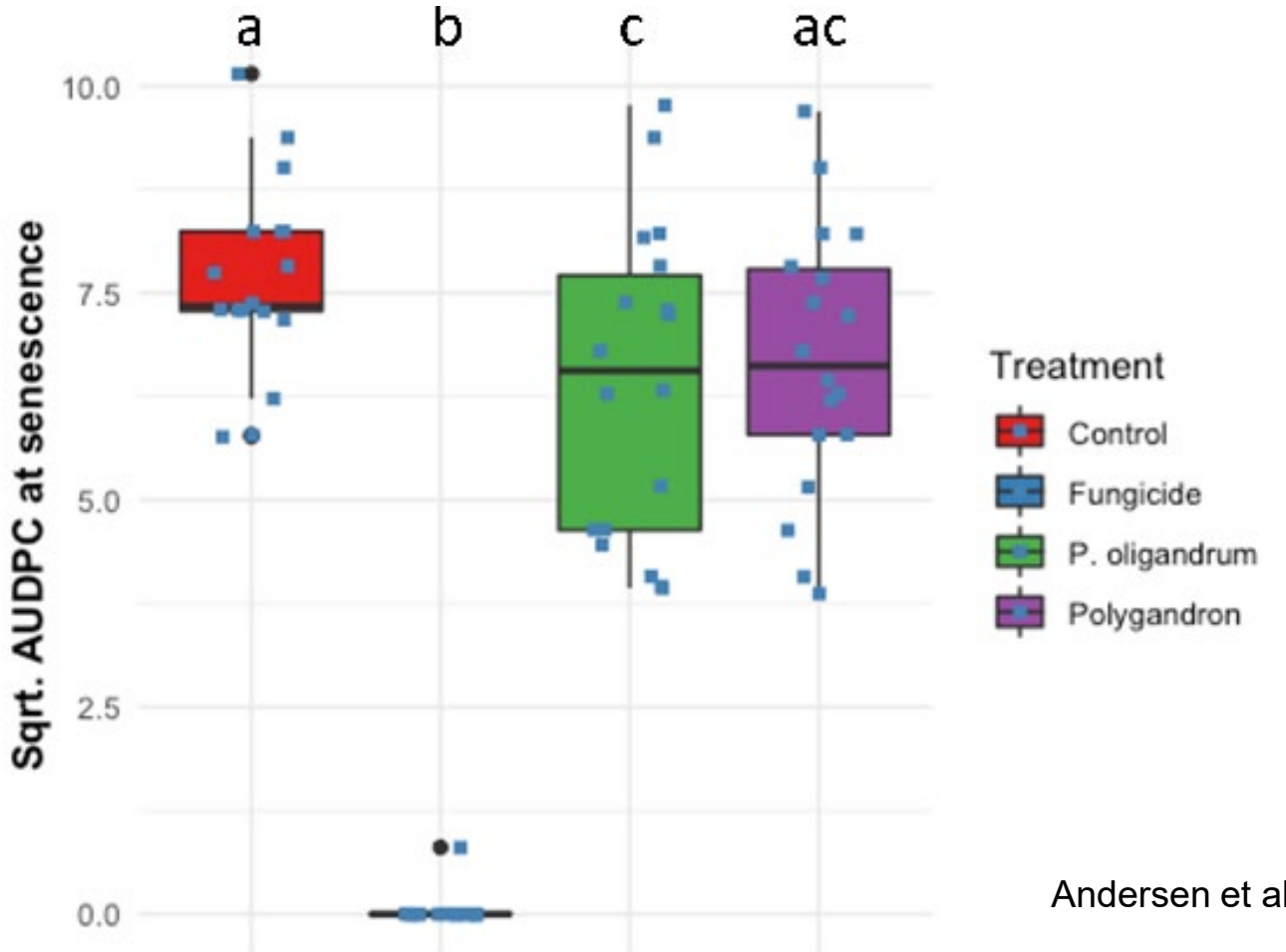
Linnea Stridh

Follow up: Long-term survival of *A. solani* in sandy vs. clay soil and the effect of landscape factors on disease. See Chiara De Pasqual's poster!

Erland Liljeroth

Ongoing studies - disease control using biologicals and effects on the soil microbiome

Control effects of the oomycete mycoparasite *Pythium oligandrum*



Licenced in Europe under the trade names Polygandron & Polyversum

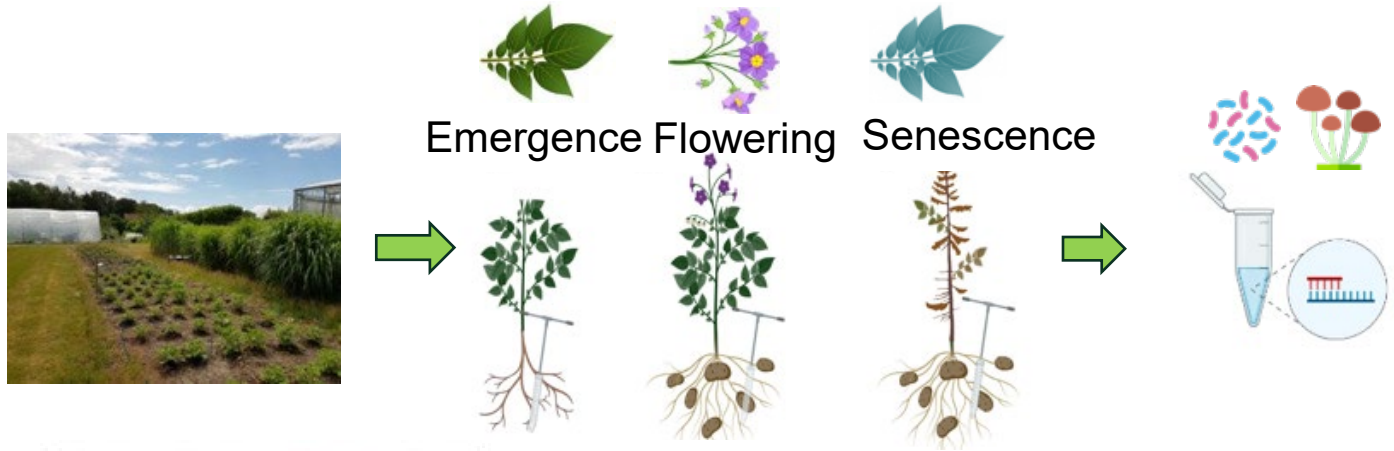
A lab strain had some control effect

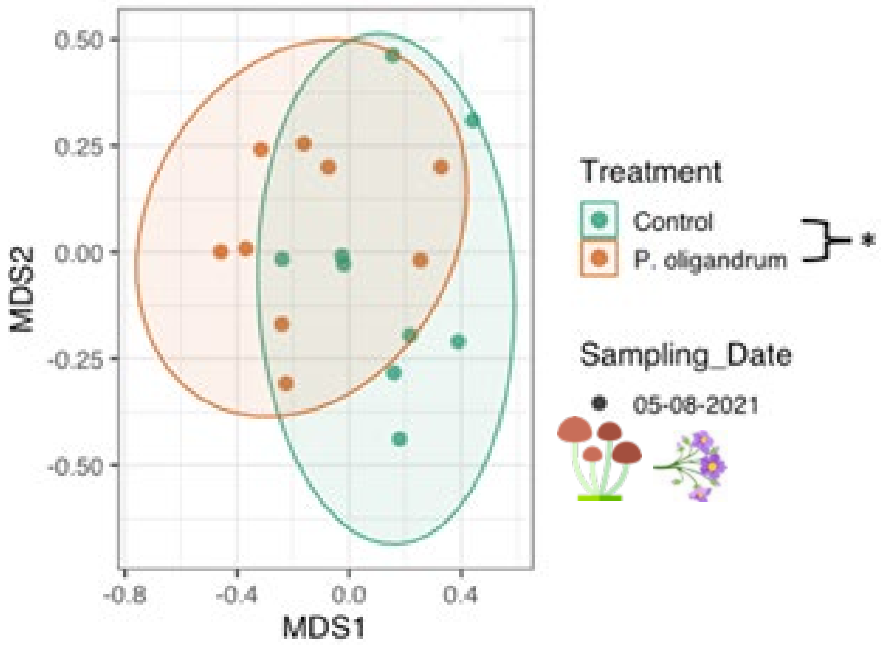
Christian Andersen

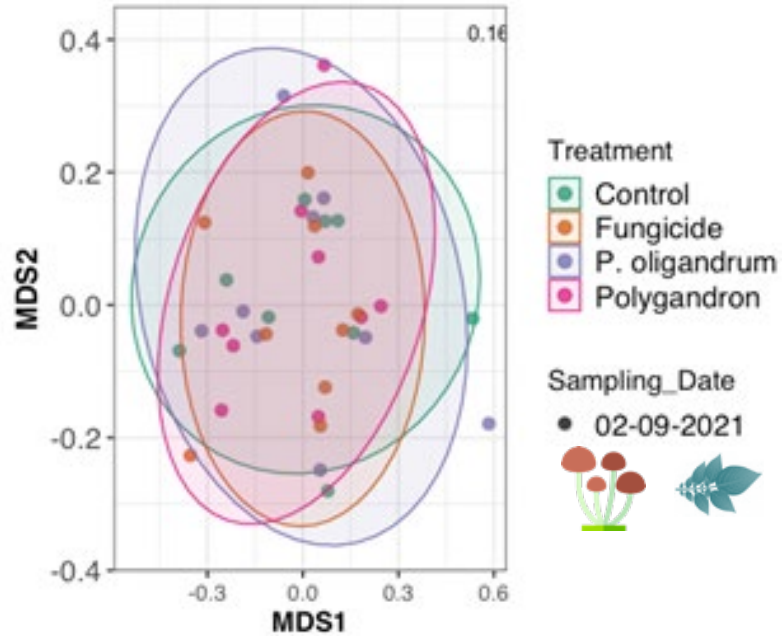
Laura Grenville Briggs

Andersen et al. In prep

Ongoing studies - disease control using biologicals and effects on the soil microbiome







P. oligandrum induces transient microbiome changes

No major environmental soil effects of this biocontrol agent

Andersen et al. In prep

Ongoing studies - mitigation of fungicide resistance development in relation to IPM

Jacob Johansson

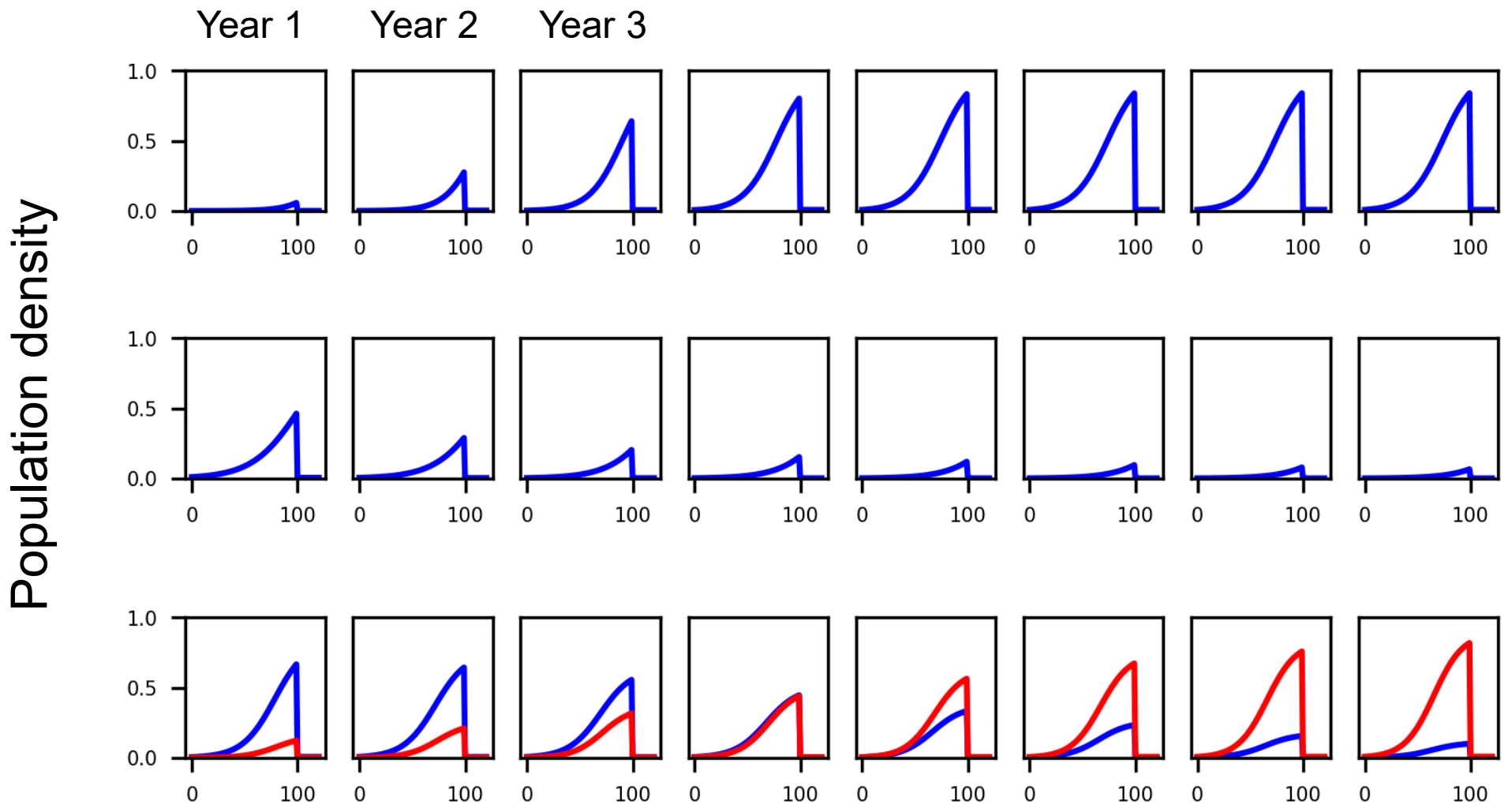
Modelling how IPM treatments impact resistance evolution of tolerance to fungicides in *A. solani* (or similar pathogen)

Adaptive dynamics (population dynamics, pathogens can evolve)

Assumptions:
- Pathogen types with 0-100% fungicide tolerance
- Survival of pathogen types depends on fungicide tolerance vs. amount of spraying
- Pathogen growth is affected by a cost of fungicide tolerance
- Survival between years and spreading between fields

Parameters reflect IPM treatments; G0) Growth rate/crop resistance/biocontrol, SW) Treatments affecting pathogen winter survival, T) Season length/potato cultivar

Alternaria population dynamics in a single field



Infection by wild type (0% tolerance)

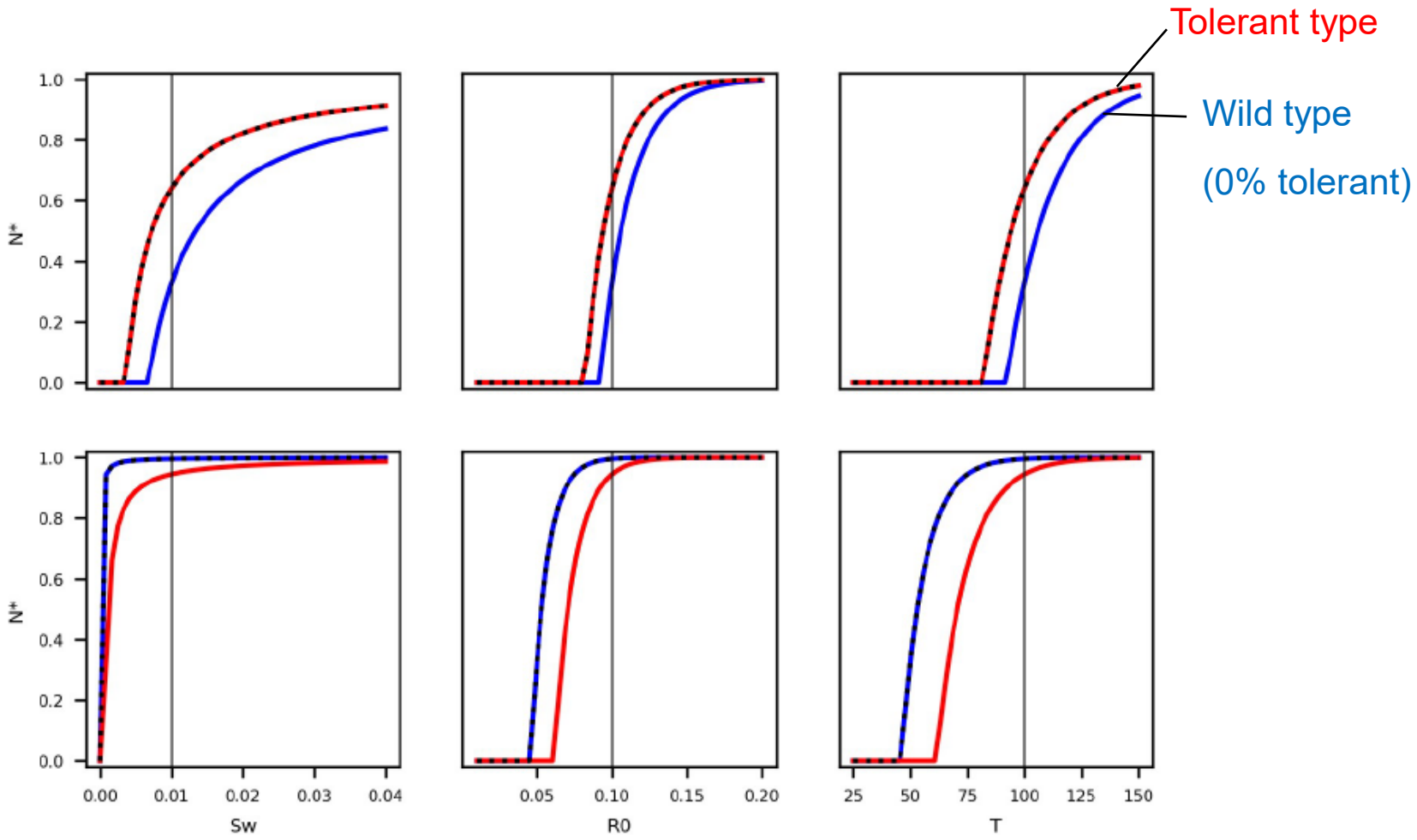
Control of wild type

Invasion by tolerant type

With fungicides the tolerant type can invade at a lower threshold and obtain a higher population size. Adding any IPM treatment will kill the wild type first (as less favoured).

Population density with fungicides

Population density without fungicides

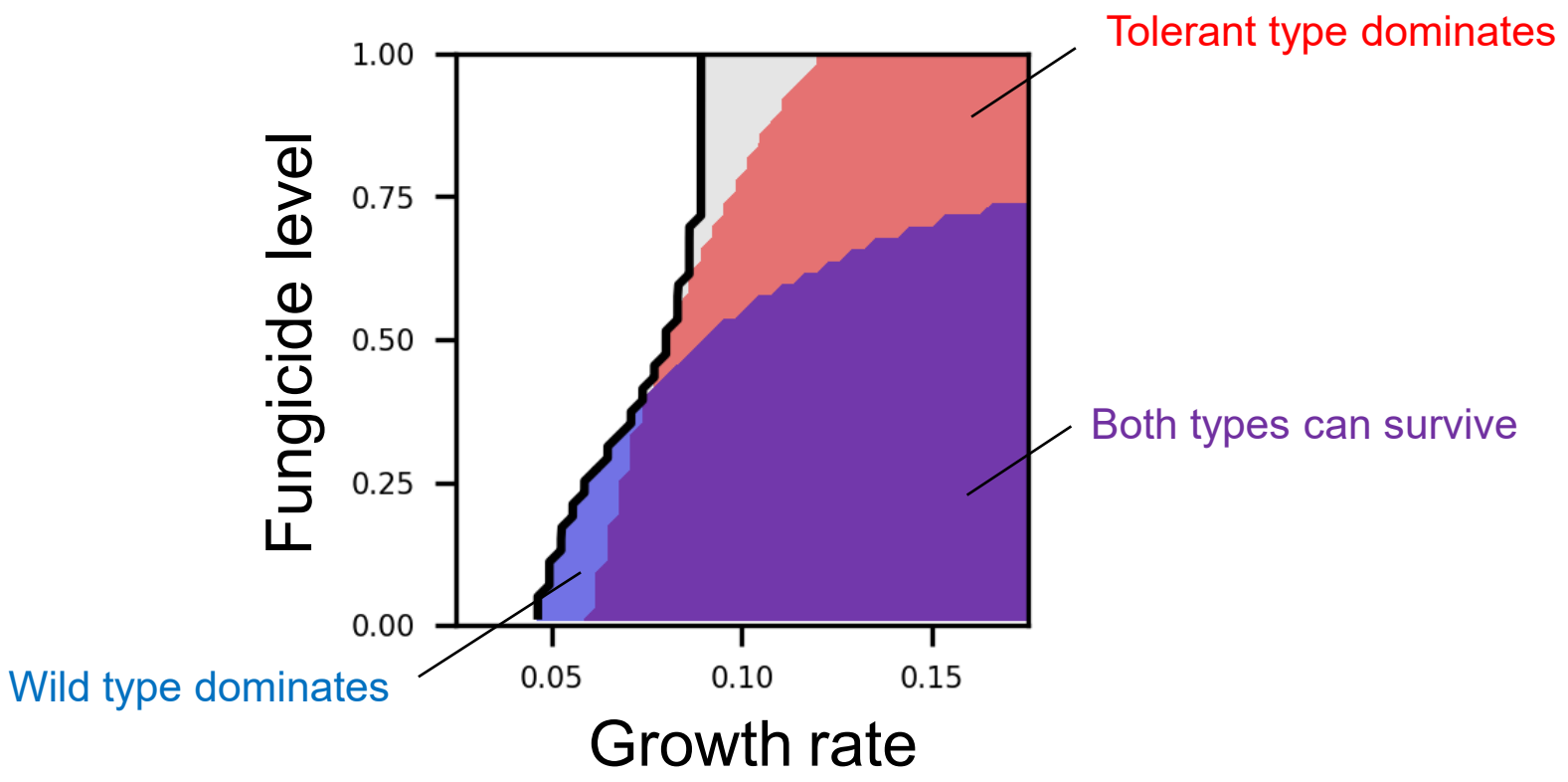


Winter survival

Growth rate

Season length

The model can be used to identify how IPM and fungicide levels jointly influence resistance evolution



Ongoing analysis of the model in relation to partial substitution of fungicides, effects of temporal and spatial variation in treatments

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Preliminary summary

- IPM treatments not accompanied by reduced fungicide use, is inefficient against resistance since it will first kill the wild type, then the tolerant type.
- Partial substitution can reduce resistance. Substituting fungicide with within-season treatments appear more efficient than with between-season treatments.
- Temporal and spatial variation in treatments differ in efficiency both regarding mitigation of resistance and infection – temporal variation appears more efficient.
- Mitigating resistance as well as reducing infections does not always go hand in hand, e.g. fallow years appear to reduce infection but not resistance evolution.

Summary

To improve implementation of IPM for early blight we need to learn more about various factors that influence the pathogen, e.g. long-term survival.

The biocontrol *Pythium oligandrum* showed some disease-controlling effect of a lab strain, but not a commercial product, and transient soil microbiome effects.

According to ongoing mathematical modelling IPM treatments as partial substitution can mitigate resistance evolution to fungicides.

Photo: L. Stridh

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