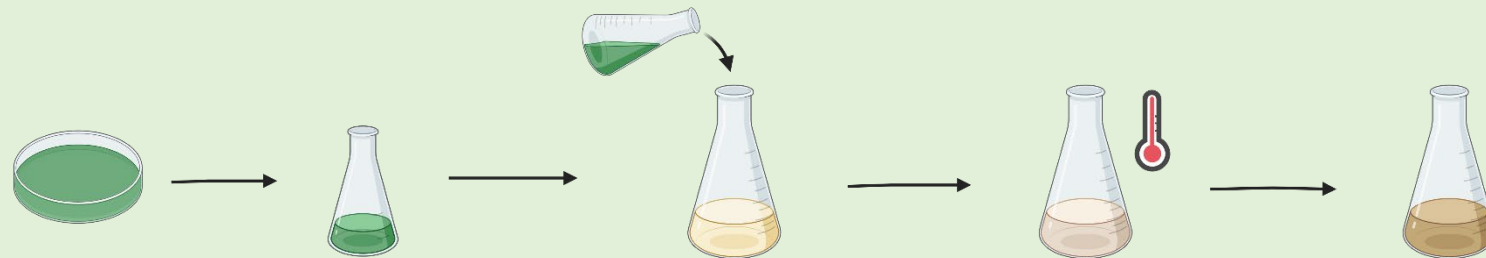


How culture filtrates of *Trichoderma* spp. influence the reaction of potatoes to early blight (*Alternaria solani*)



EuroBlight Workshop Lunteren

15th May 2024

Carolin Brune, Ralph Hückelhoven, Hans Hausladen

Alternaria solani

- › Necrotrophic fungus
- › Can lead to up to 40 % yield reduction in Germany
(Leiminger and Hausladen (2014), *Gesunde Pflanzen*)
- › Increasing number of fungicide resistances



Woudenberg et al. (2014), *Studies in Mycology*

Trichoderma spp.

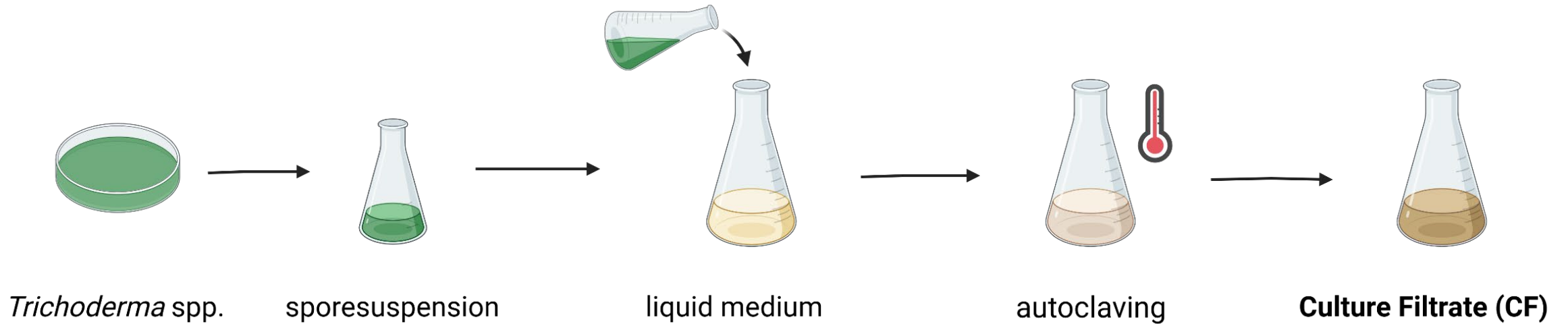
- › Soil-borne fungus
- › Already identified as biological control agent in 1932
(Weindling (1932), *Phytopathology*)
- › Mostly living fungus or purified secondary metabolites

➔ excluding the living fungus from practical applications



Different *Trichoderma* spp. isolates on PDA

Culture Filtrates (CF)



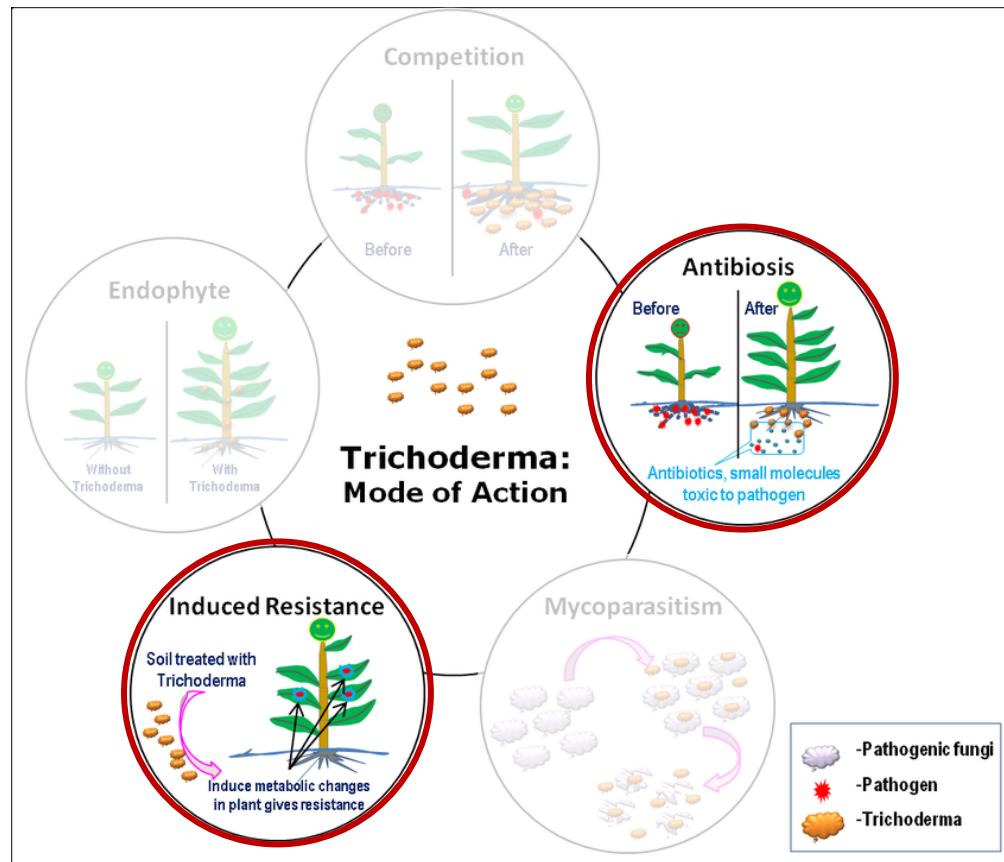
***Trichoderma* isolates**

T. atroviride 20780

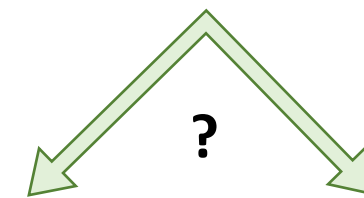
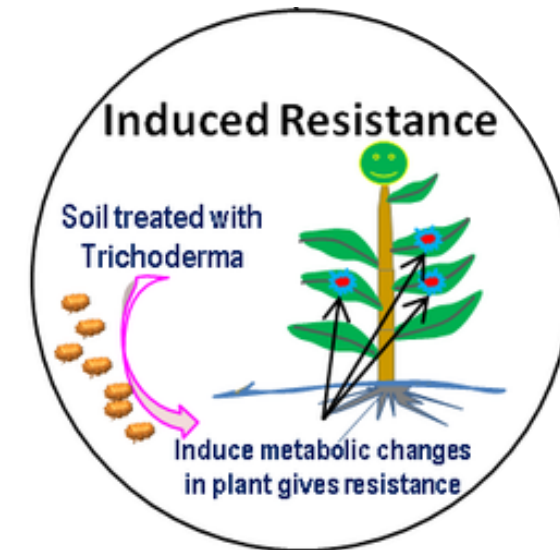
T. asperellum 20866

- Defined density of spores in medium
- Only heat-stable components
- Leftover fungal cells damaged in autoclaving process

Trichoderma spp. Modes of Action



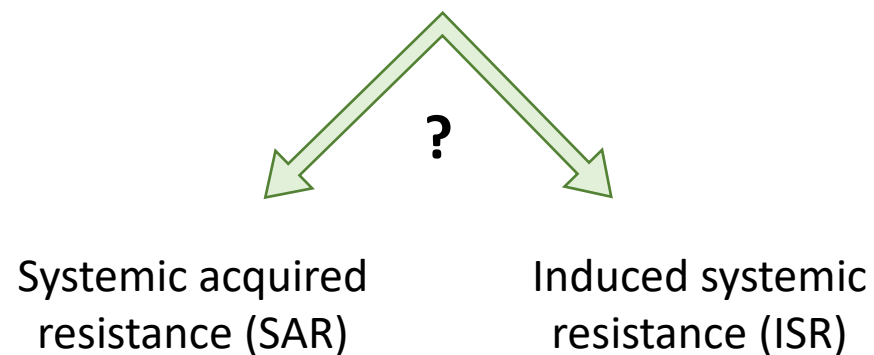
Waghunde et al. (2016), *African journal of agricultural research*



Systemic acquired resistance (SAR)

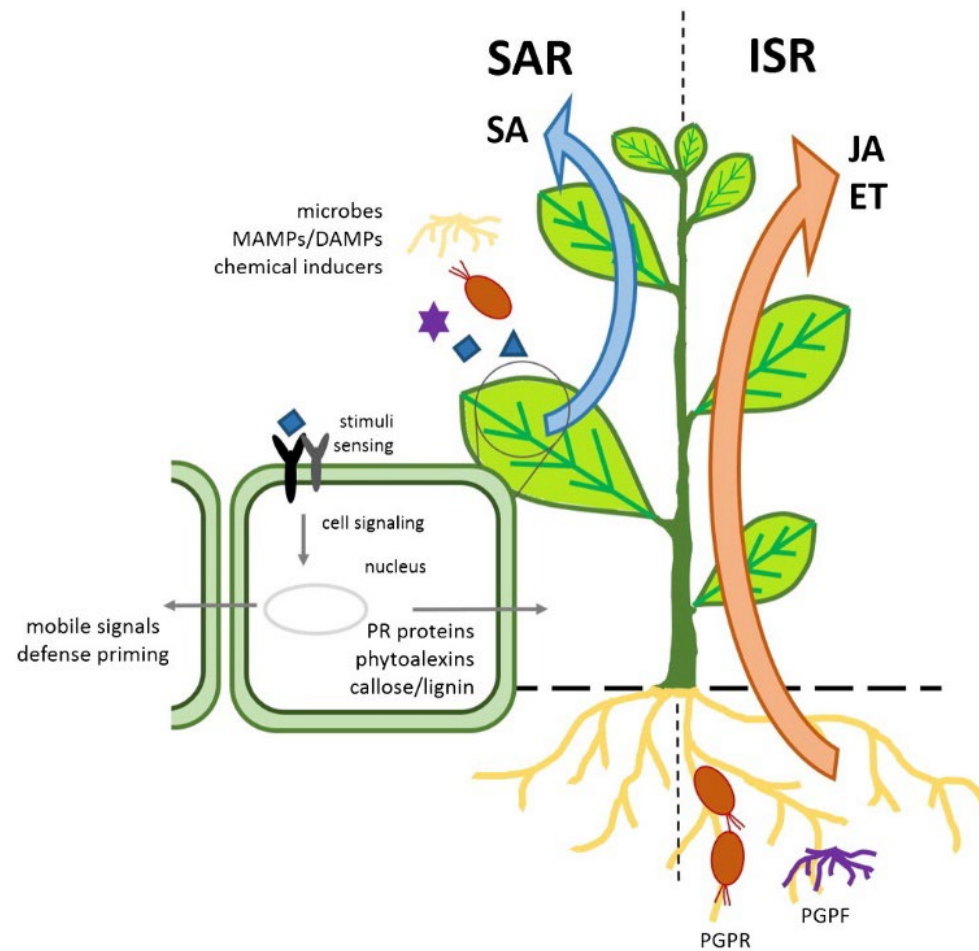
Induced systemic resistance (ISR)

Induced resistance



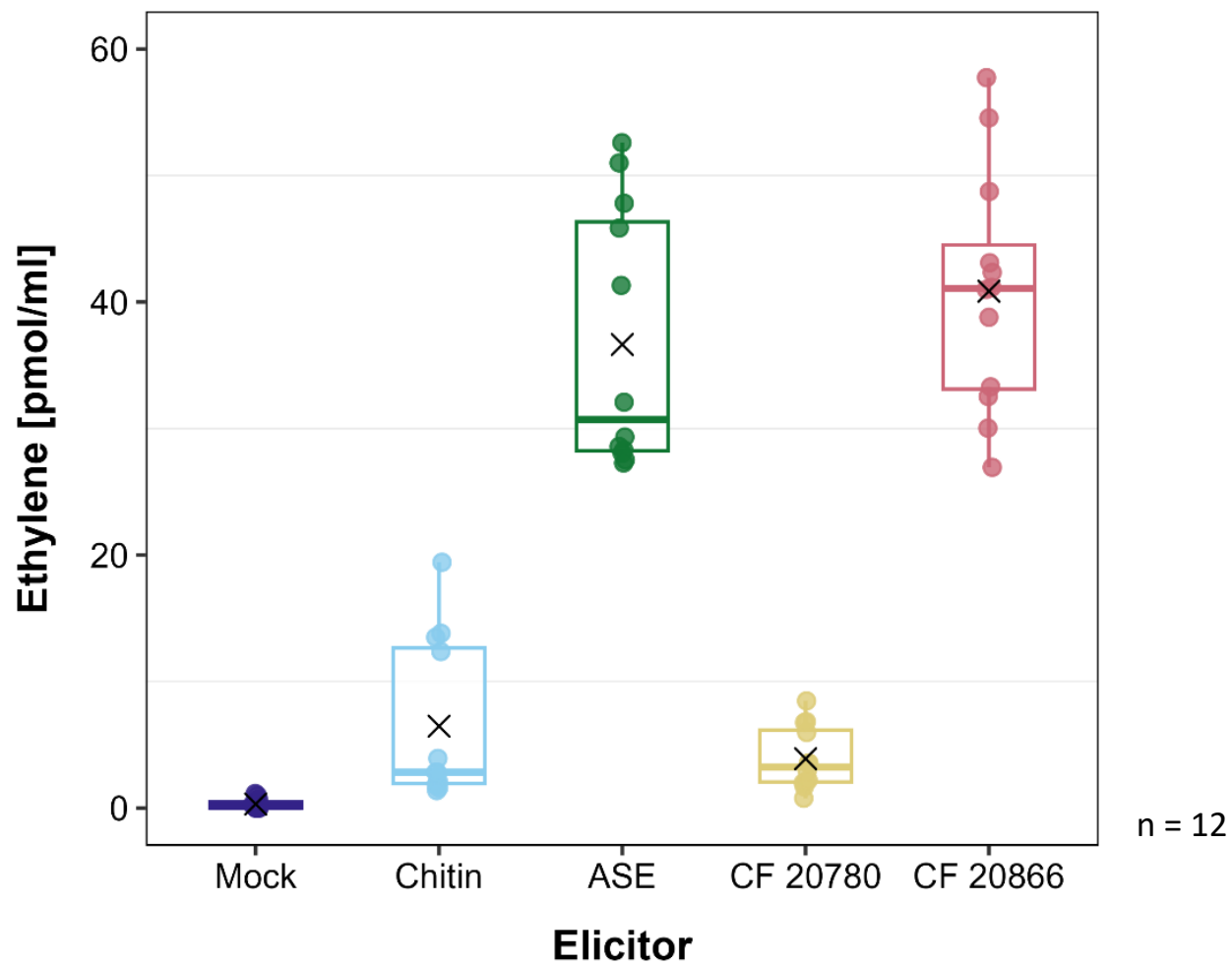
Regulation in potatoes?
 Root treatment = ISR?
 Influence of BCA and *A. solani*?

⚡ Conflicting results in literature for potatoes



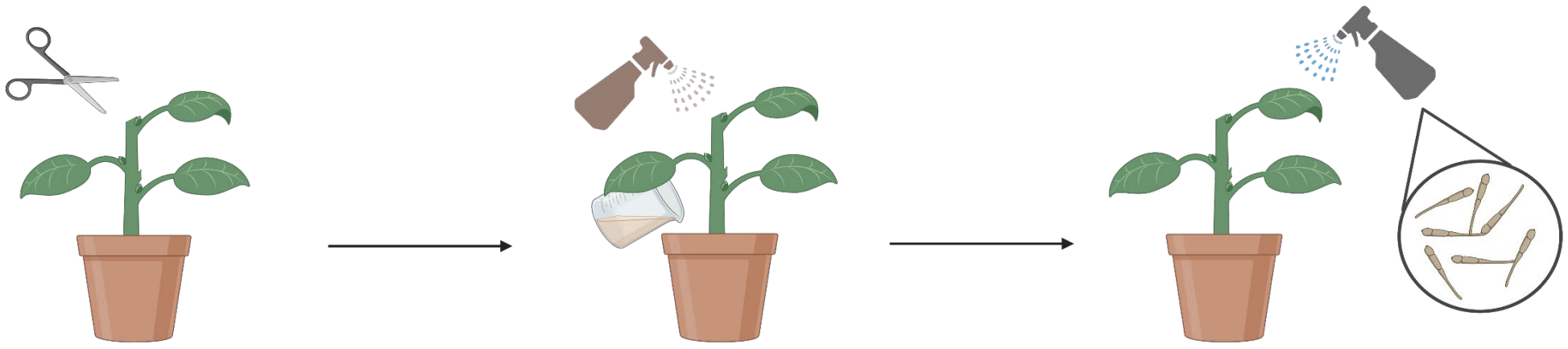
Burketova et al. (2015), *Biotechnology advances*

Ethylene – CF as Elicitor



- › 20780 on chitin levels
→ inducing other defence related mechanisms?
- › 20866 on ASE levels

General Greenhouse Workflow



cutting to 3 leaves
one week prior

Trichoderma spp. CF
treatment day -1

Alternaria solani spray
inoculation day 0

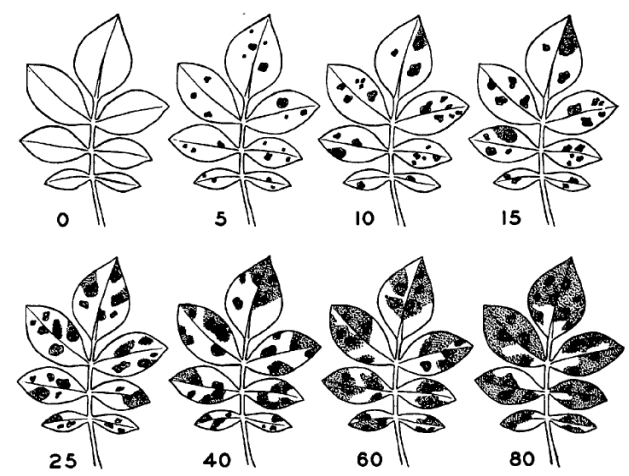
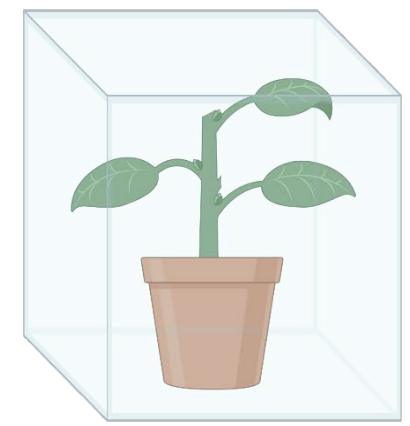


FIG. 3.—Diagrammatic chart showing percentages of early blight injury on potato leaves.

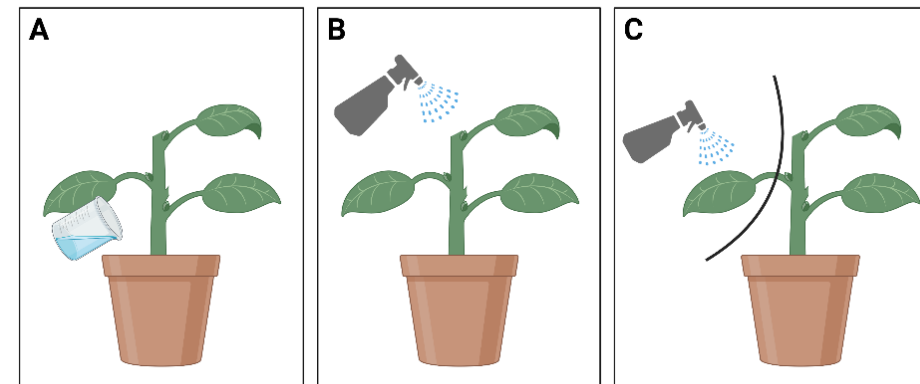
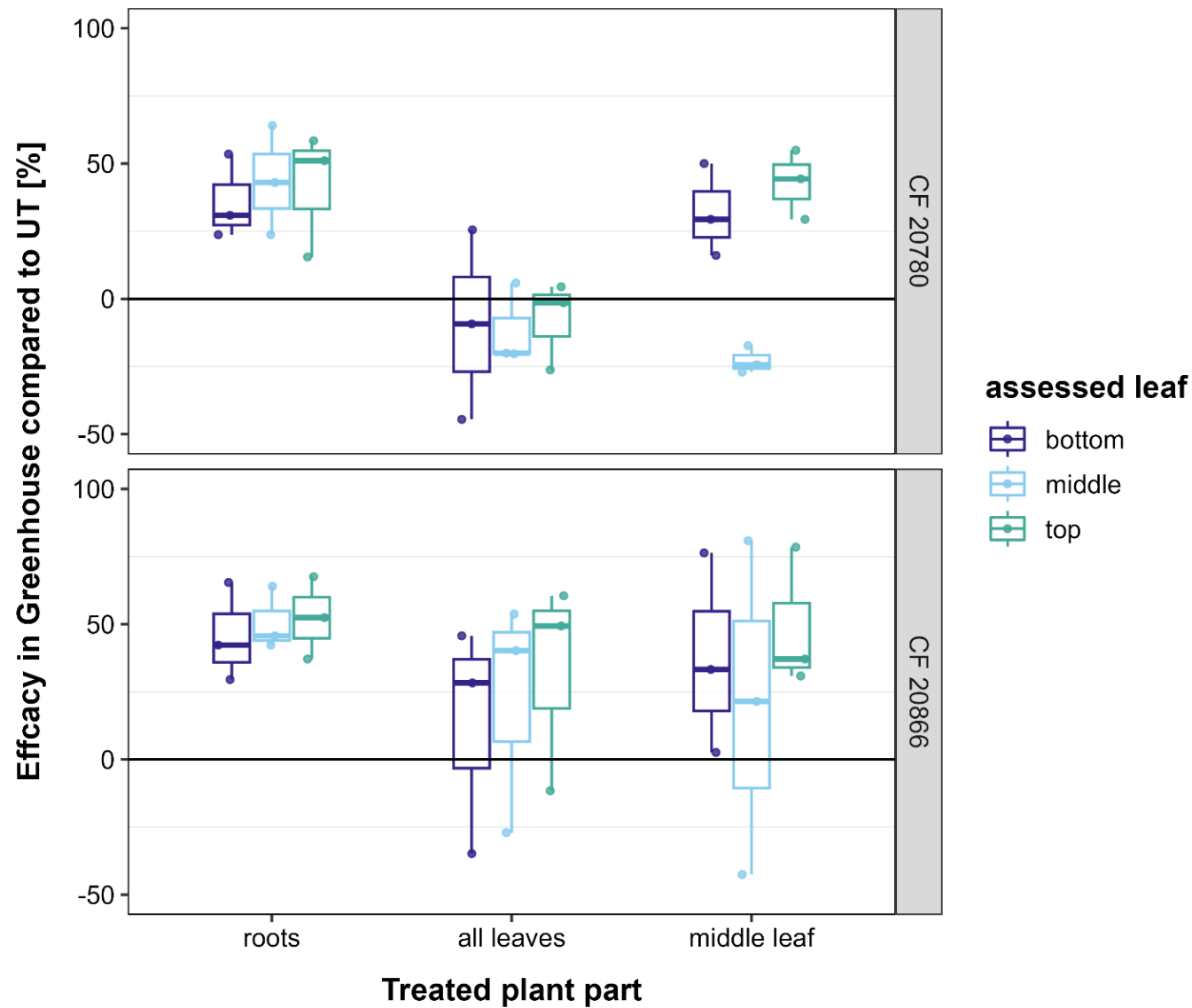
disease assessment
day 7



infection tent for 48 h

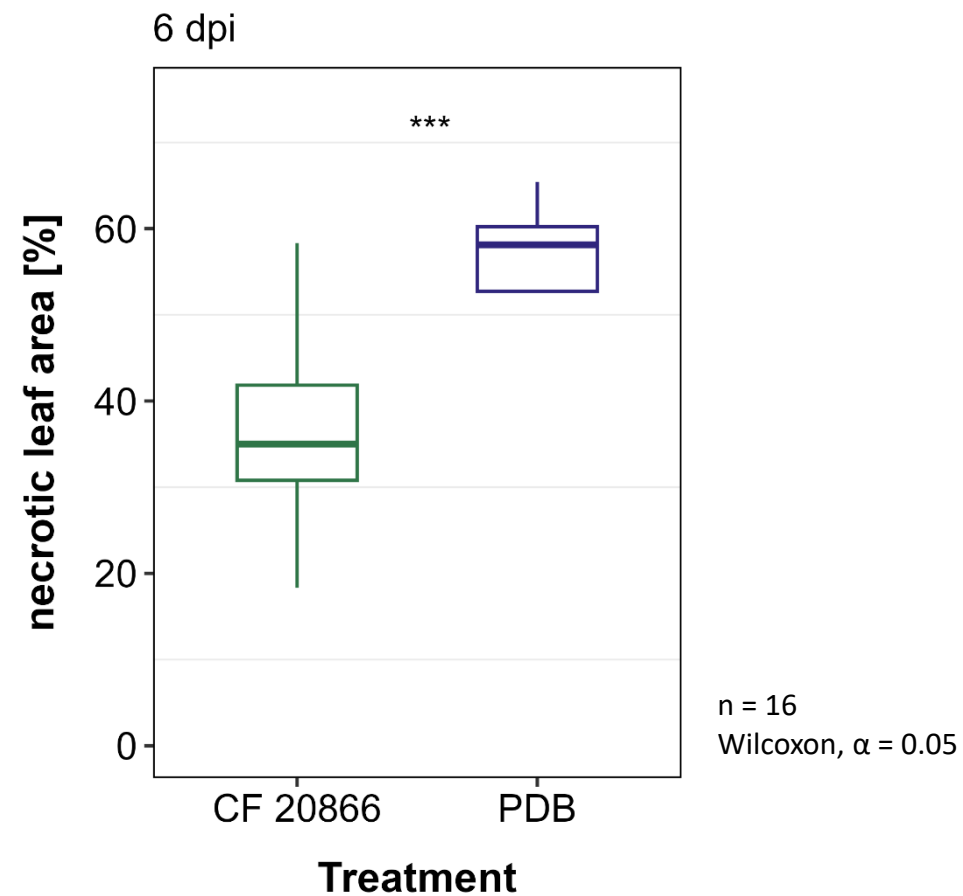
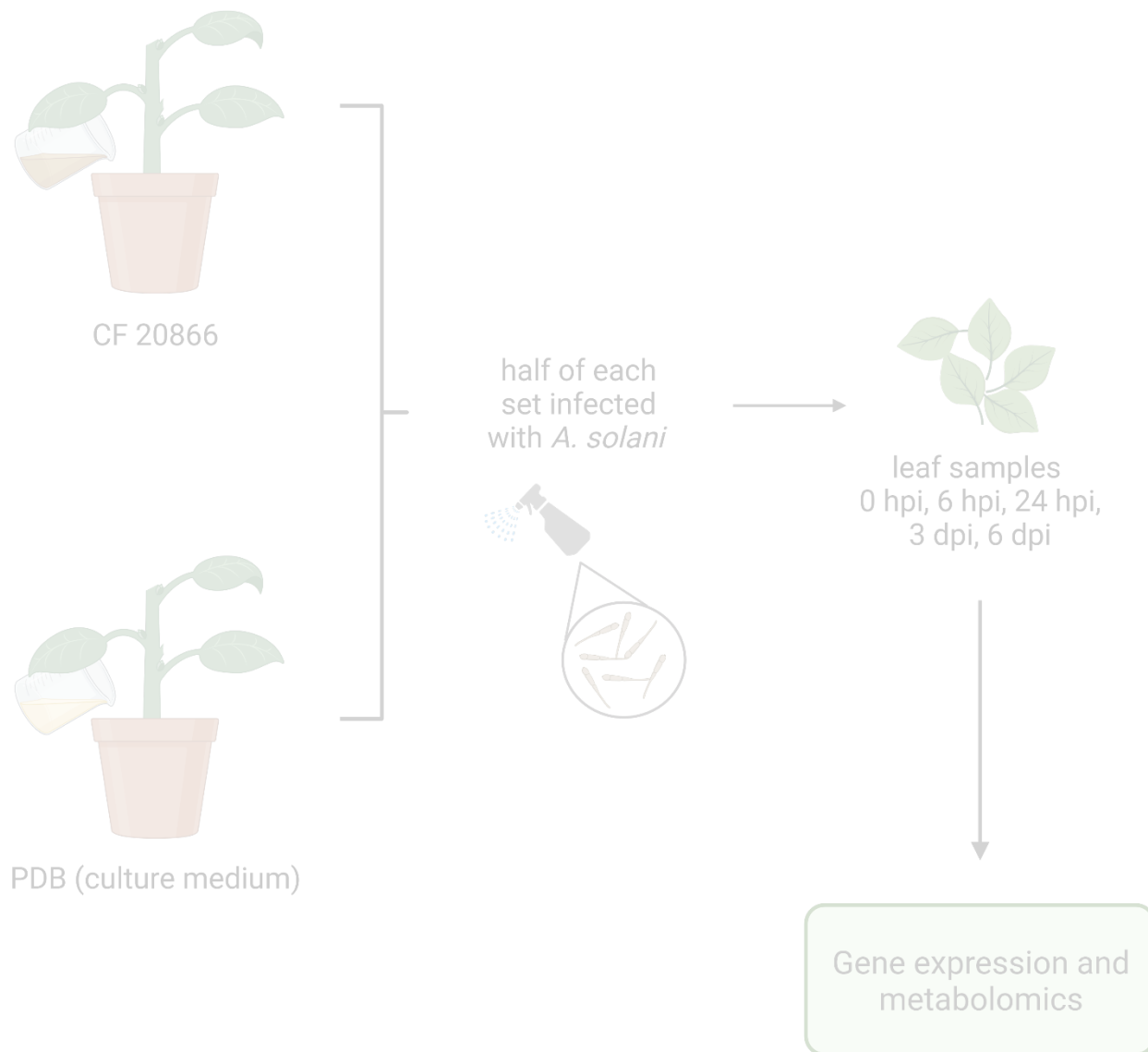
CF = culture filtrate

Systemic effect



- › With 20780 clear difference between treated and non-treated leaves
- › With 20866 mainly differences in variability

Gene Expression Trial - Setup



CF = culture filtrate
PDB = potato dextrose broth

Salicylic acid pathway

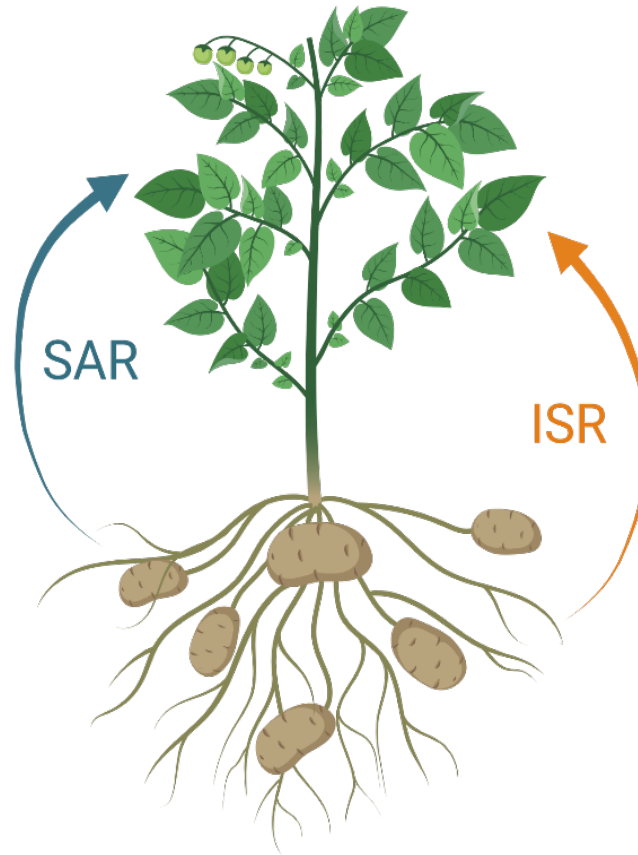
Phenylalanine ammonia-lyase (*PAL2*)

pathogenesis-related proteins:

PR-1b

Chitinase (*PR-3*)

Thaumatine-like protein (*PR-5*)



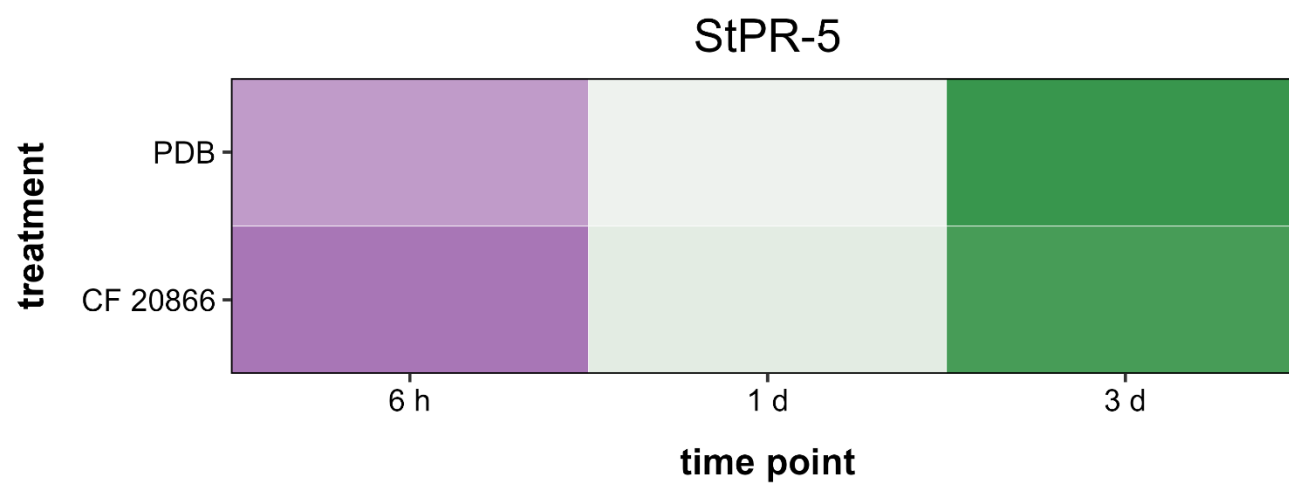
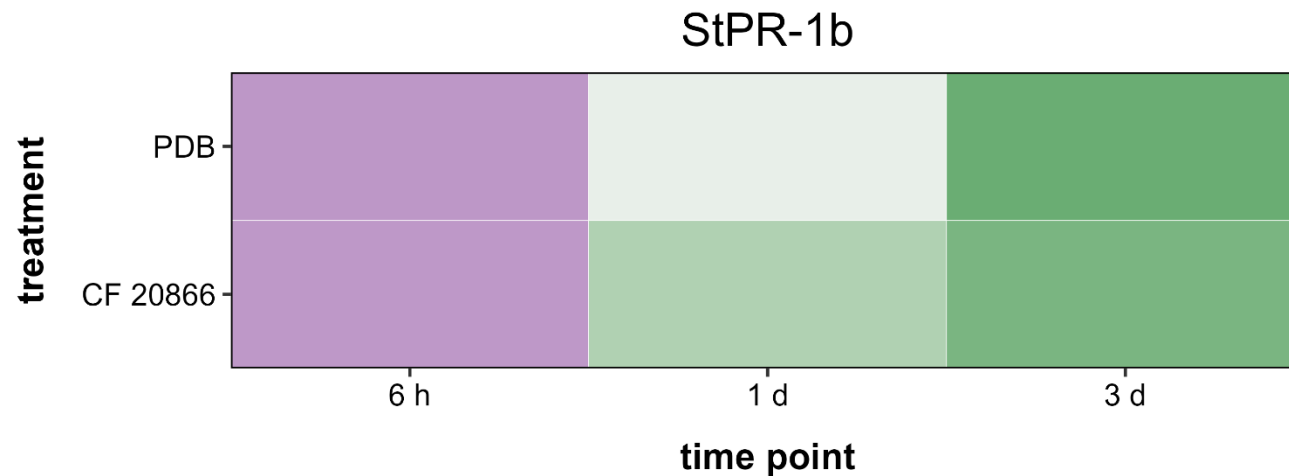
Jasmonic acid/ ethylene pathway

Lipoxygenase (*LOX*)

Aminocyclopropene-1-carboxylate oxidase (*ACO*)

Ethylene response factor (*ERF*)

Gene Expression - examples



Preliminary data

- › SA pathway influenced rather by infection than CF treatment
- › PR-1b upregulated faster with CF
- › JA/ET pathway stronger influenced?

PR = pathogenesis-related protein
CF = culture filtrate

Summary and Outlook

→ There is a systemic effect, we don't know how exactly

Which pathways mainly contribute? Both?

- › Testing expression of more genes
- › Metabolomics (Lina Muñoz, TUM)
- › Active compounds in CFs (practical application?)
- › Closer insight into regulatory mechanisms

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