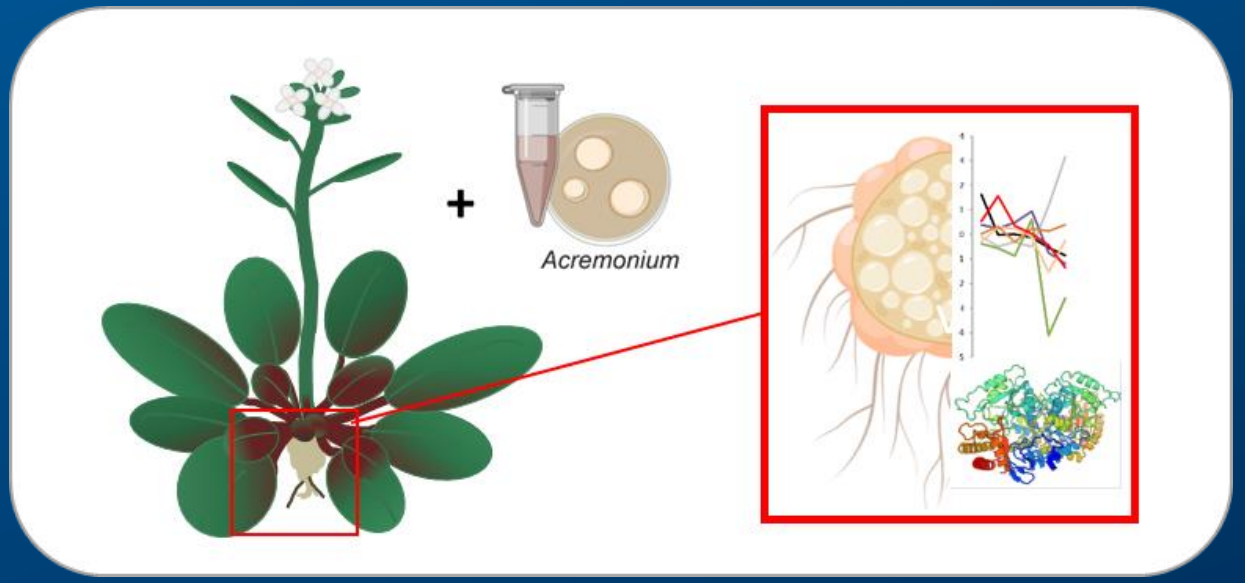
Jutta Ludwig-Müller and Susann Auer
Clubroot Steering Committee Meeting, 30 April 2020

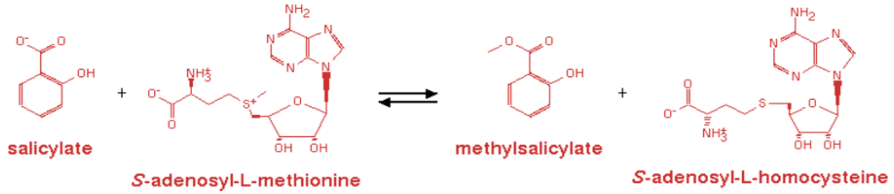
# Biocontrol potential for clubroot by *Acremonium alternatum* – chances and challenges

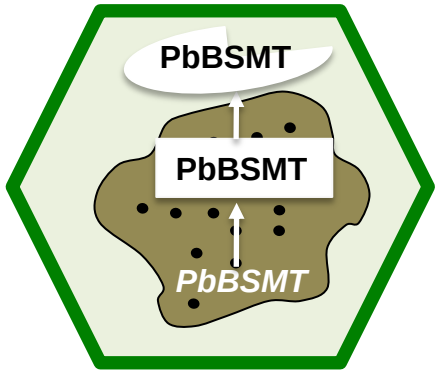


# The defense compound salicylic acid can be derivatized by an effector of *P. brassicae*

*Plasmodiophora* has a protein with homology to plant SABATH methyltransferases

Ludwig-Müller et al., 2015, Mol. Plant Pathol.



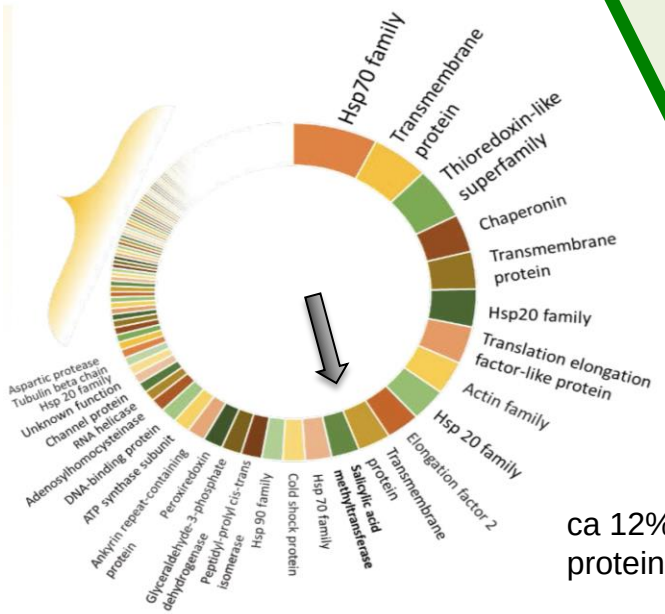




*PbBSMT* is among the highly expressed putative secreted effectors

Schwelm et al., 2015, Scientific Report

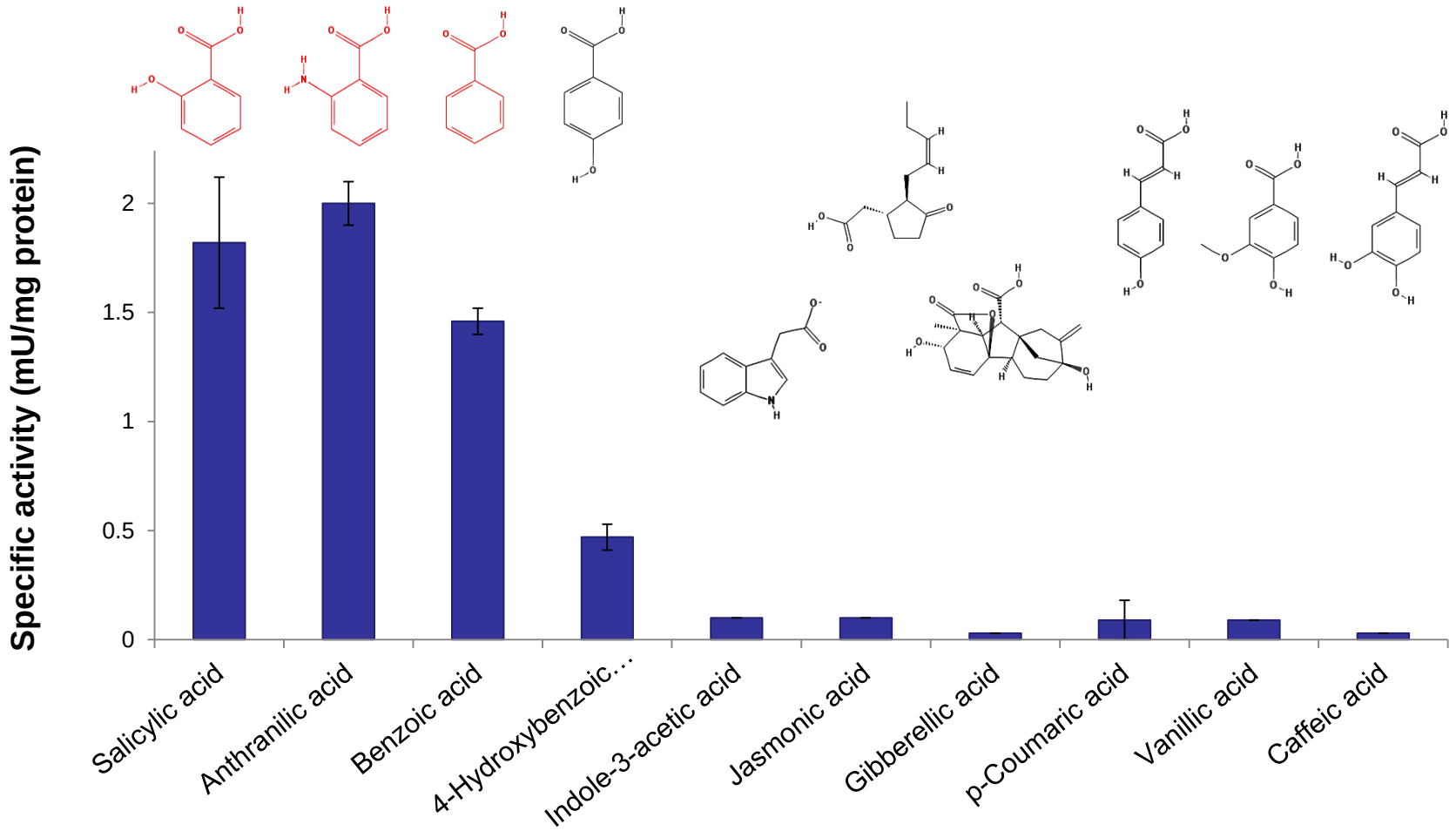
Annotation of the most abundant *P. brassicae* proteins of a proteome analysis based on their orthologs

Veronika Malych, Miroslav Berka (Mendel University, Brno)



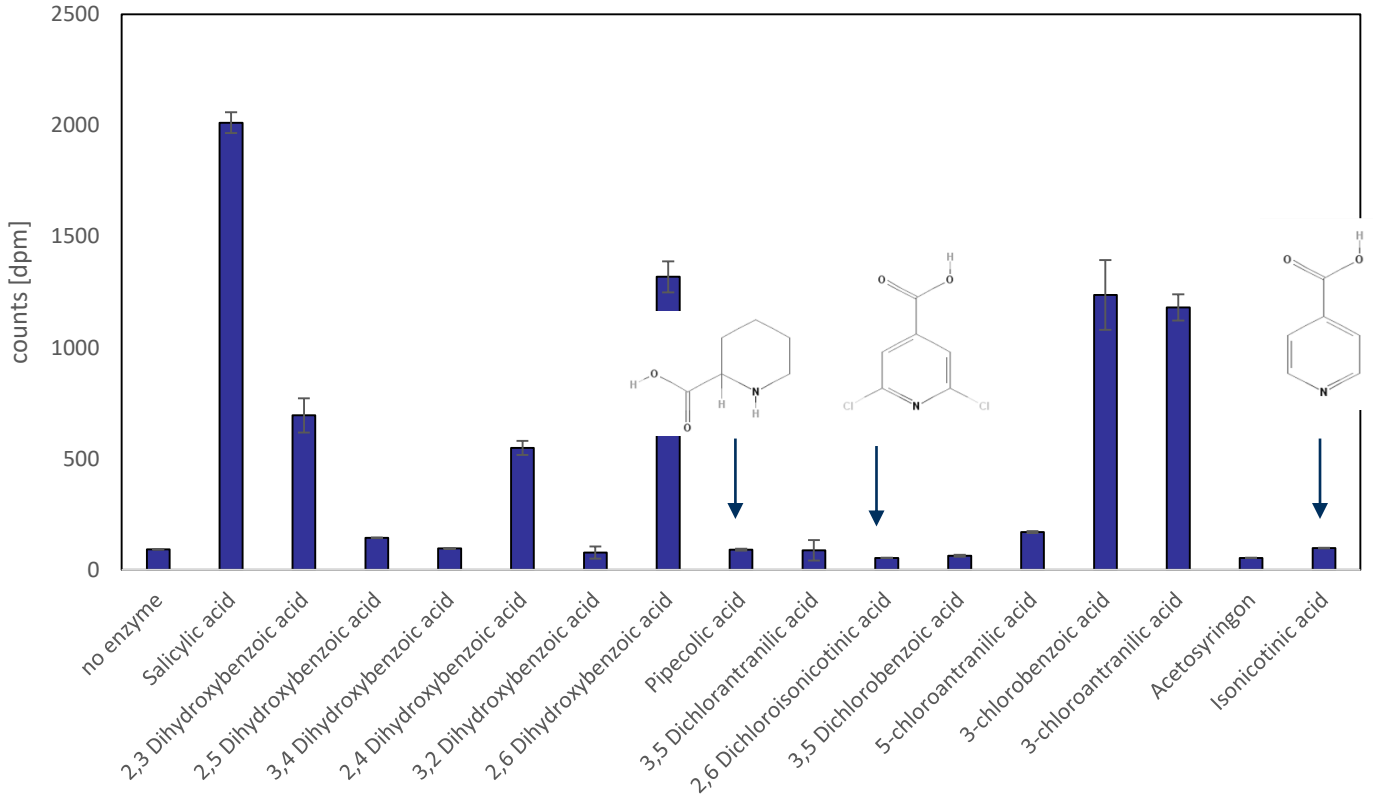

ca 12% of the total protein annotated as Pb!

# PbBSMT can methylate salicylic acid, benzoic acid and anthranilic acid




Ludwig-Müller et al., 2015, Mol. Plant Pathol.

# Can we use compounds known to induce defense but not methylated by PbBSMT?




| Condition | Disease Index | Infection rate (%) |
|---|---|---|
| Control | 83 | 98 |
| INA 100 uM | 84 | 100 |
| INA 1 mM | 79 | 100 |
| PA 100 uM | 79 | 100 |
| PA 1 mM | 72 | 93 |

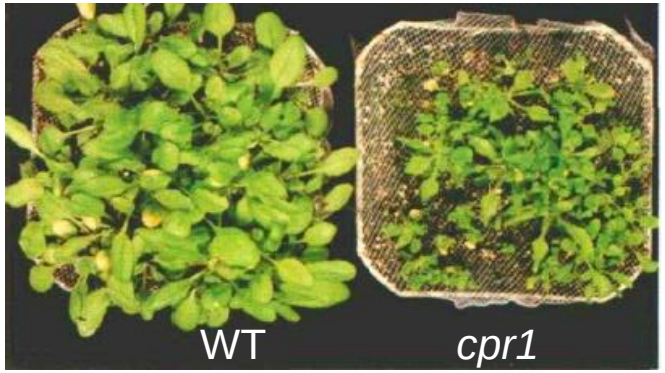
no treatment

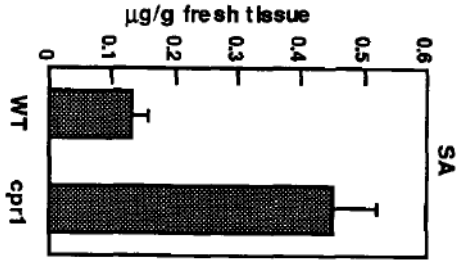
INA

PA

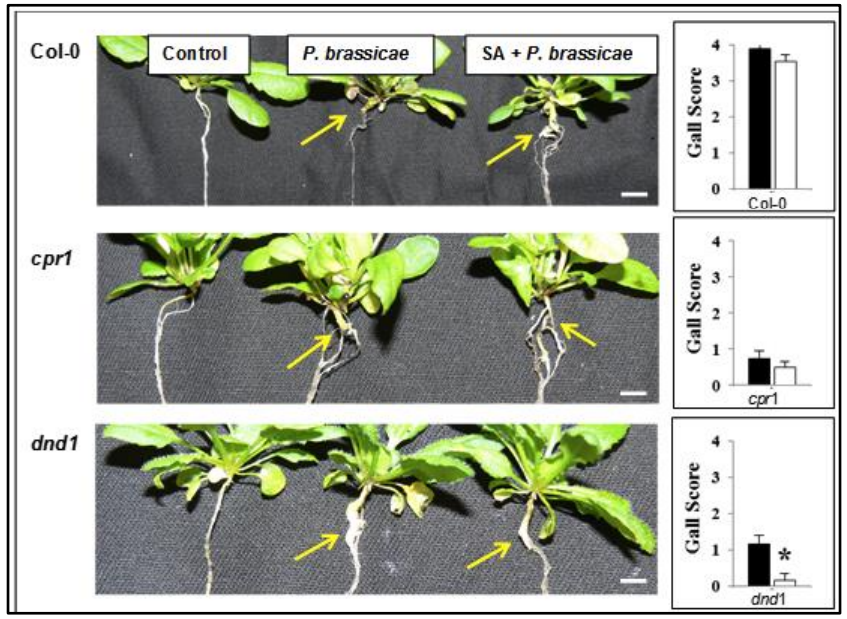
Sabine Jülke, Diana Seidler, Freia Benade

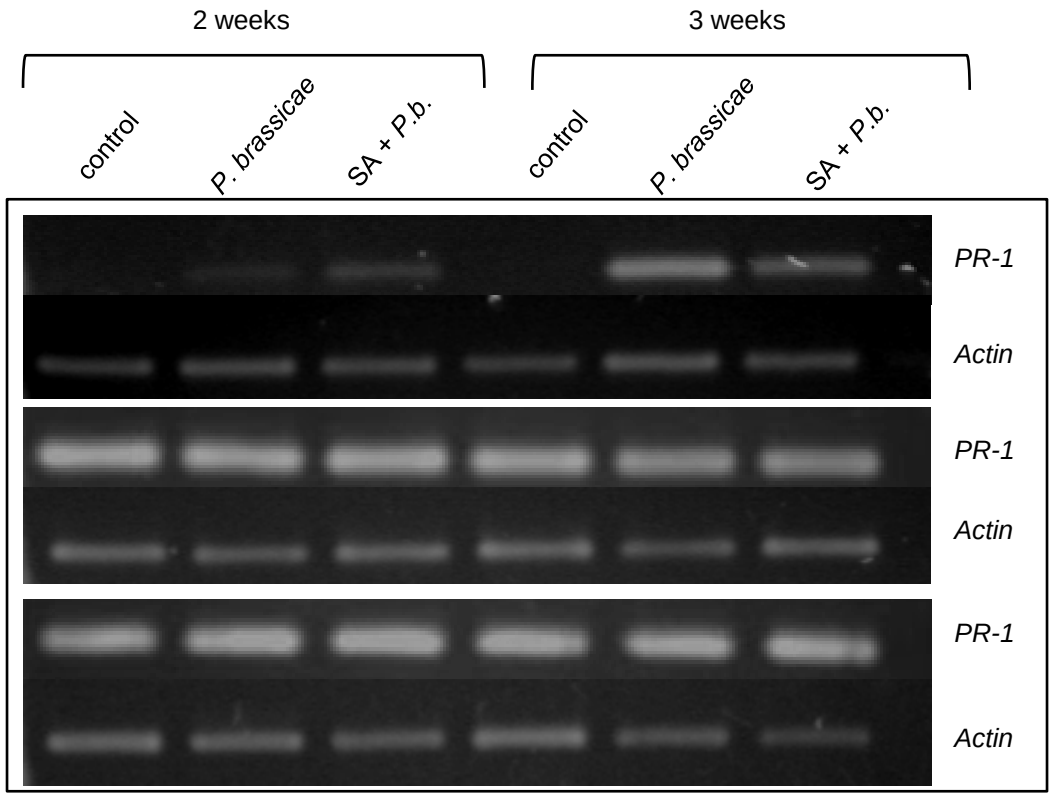
# Can we use plants with constitutively activated SA-mediated defense?



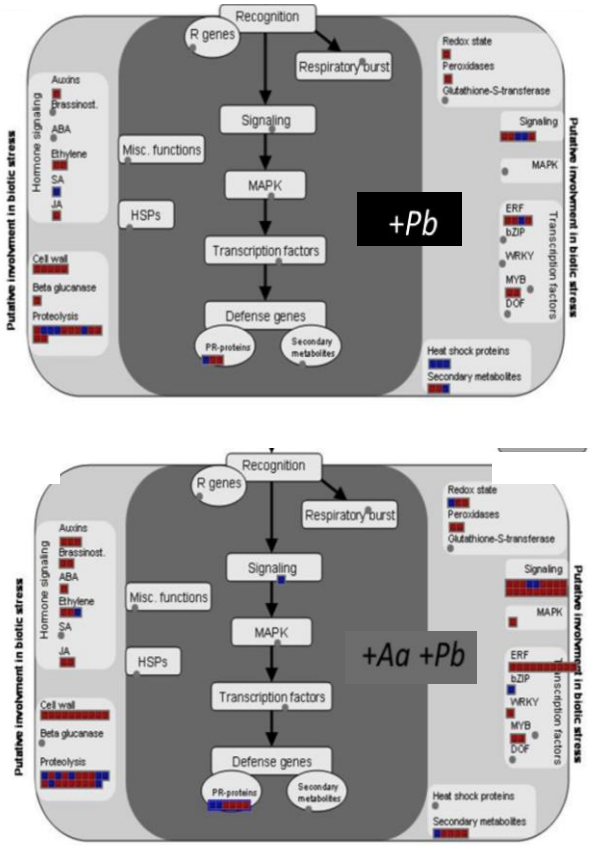

Bowling et al. (1994) Plant Cell

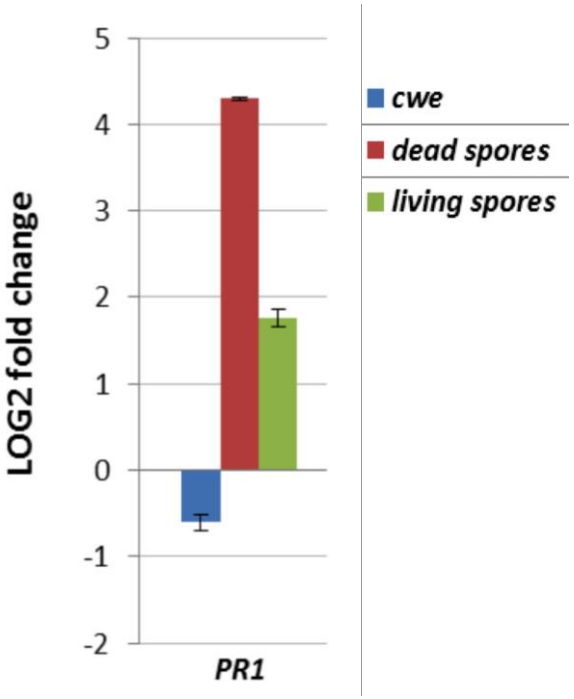



Lovelock et al, 2016, Mol. Plant Pathol.

# Defense can be induced in Arabidopsis by *Acremonium alternatum* via the salicylic acid pathway




Susann Auer

*Aa = Acremonium alternatum*
*Pb = Plasmodiophora brassicae*

up down

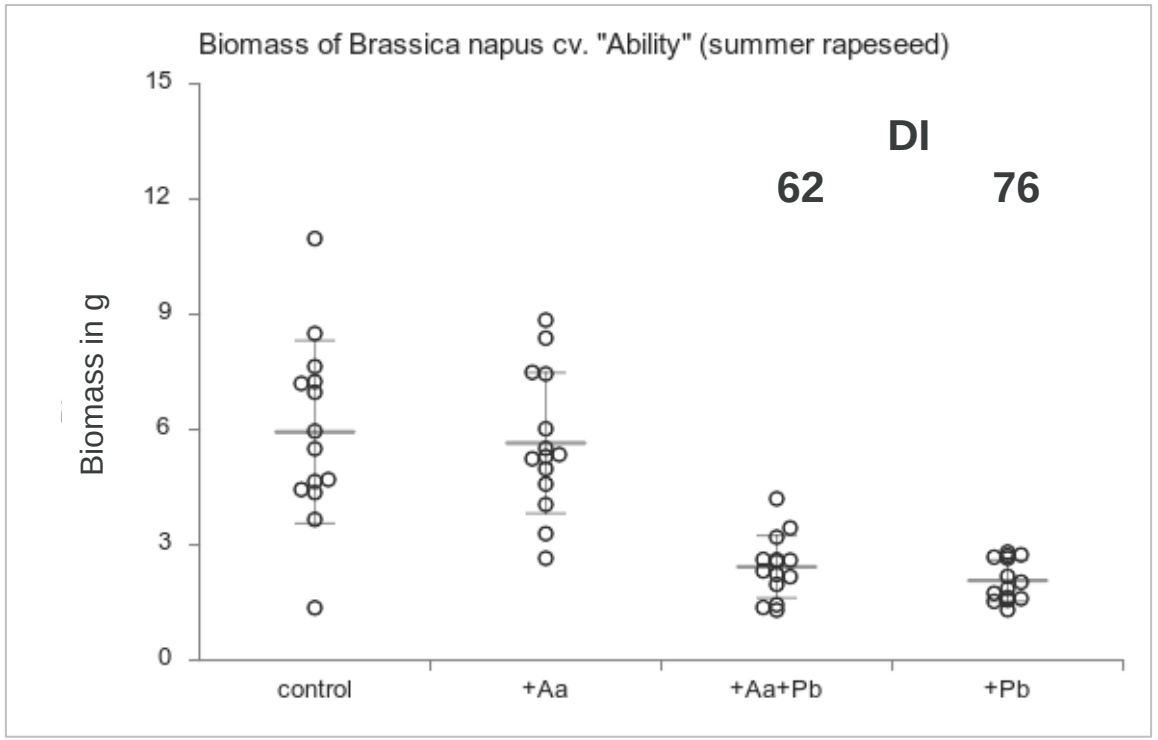
three days after inoculation

*cwe* = cell wall extract of *Aa;* dead/living spores of *Aa*
*PR1* – Pathogenesis related Protein 1 gene

# Effect of *Acremonium* on canola cultivars

**Co-inoculation with *Aa* results in a positive effect on Disease Index (DI) and biomass of plants**

(medium effect; Cohen´s $d_{AaPb\ vs\ Pb} = 0.62$)

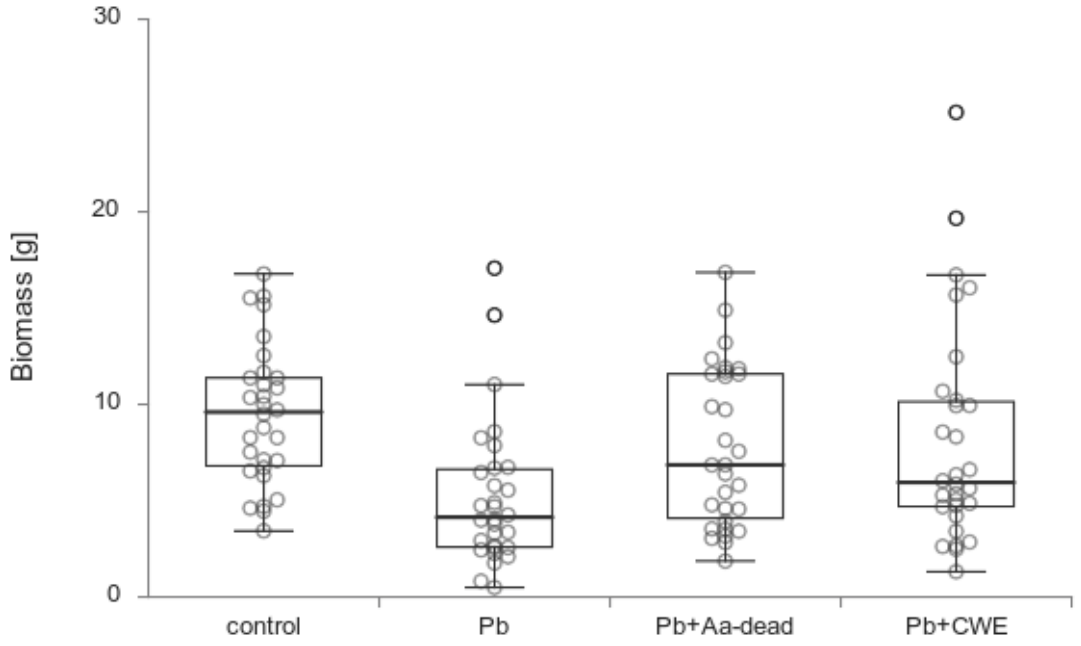


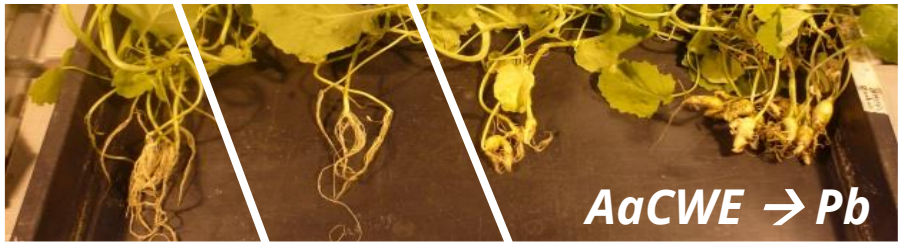

*Auer and Ludwig-Müller (2014)*

Results for tested *Brassica napus* cultivars

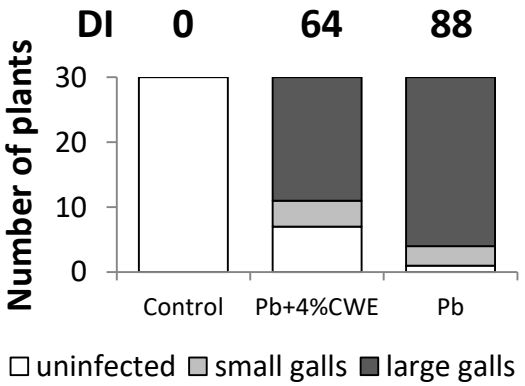
| Cultivar | *Pb* concen-tration | DI *AaPb* | DI *Pb* | n | Effect of *Aa* in % |
|---|---|---|---|---|---|
| Ability (s) | high | 62 | 76 | 14 | -18 |
| | medium | 17 | 51 | 8 | -67 |
| Visby (w) | high | 36 | 55 | 15-18 | -35 |
| | medium | 69 | 75 | 16 | -8 |
| Jennifer (w) | high | 74 | 78 | 90 | -5 |
| | medium | 28 | 61 | 90 | -54 |

# Clubroot suppression in *Brassica napus* cv. Ability by *Acremonium*



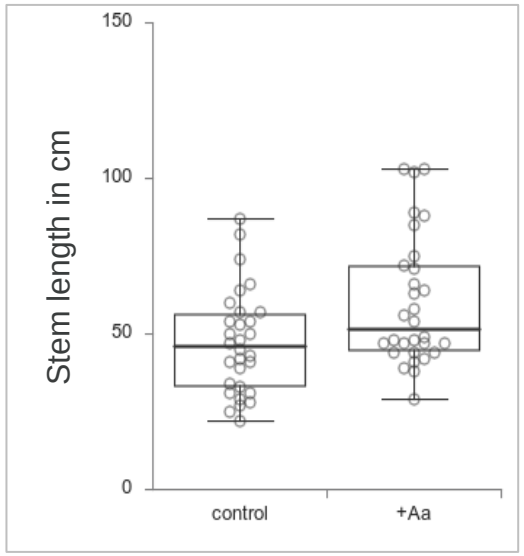



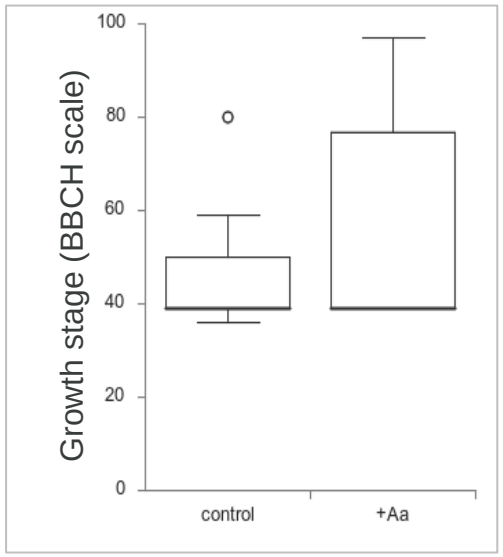

uninfected small galls large galls

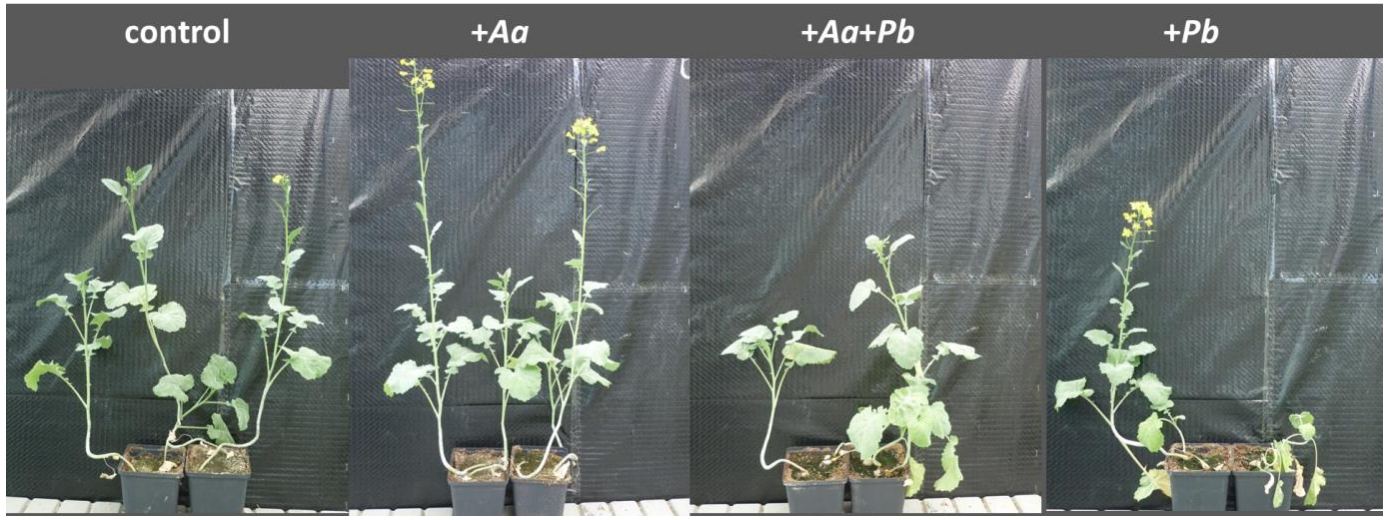




27% reduction in DI after treatment with *Aa* cell wall extract (CWE)

# *Acremonium* increases stem length and yield of „Ability“




*Brassica napus* cv. Ability, 5 months old

# Clubroot resistance is cultivar-dependent!

active genes in canola vary and are largely dependent on parent plants → implications for resistance response!

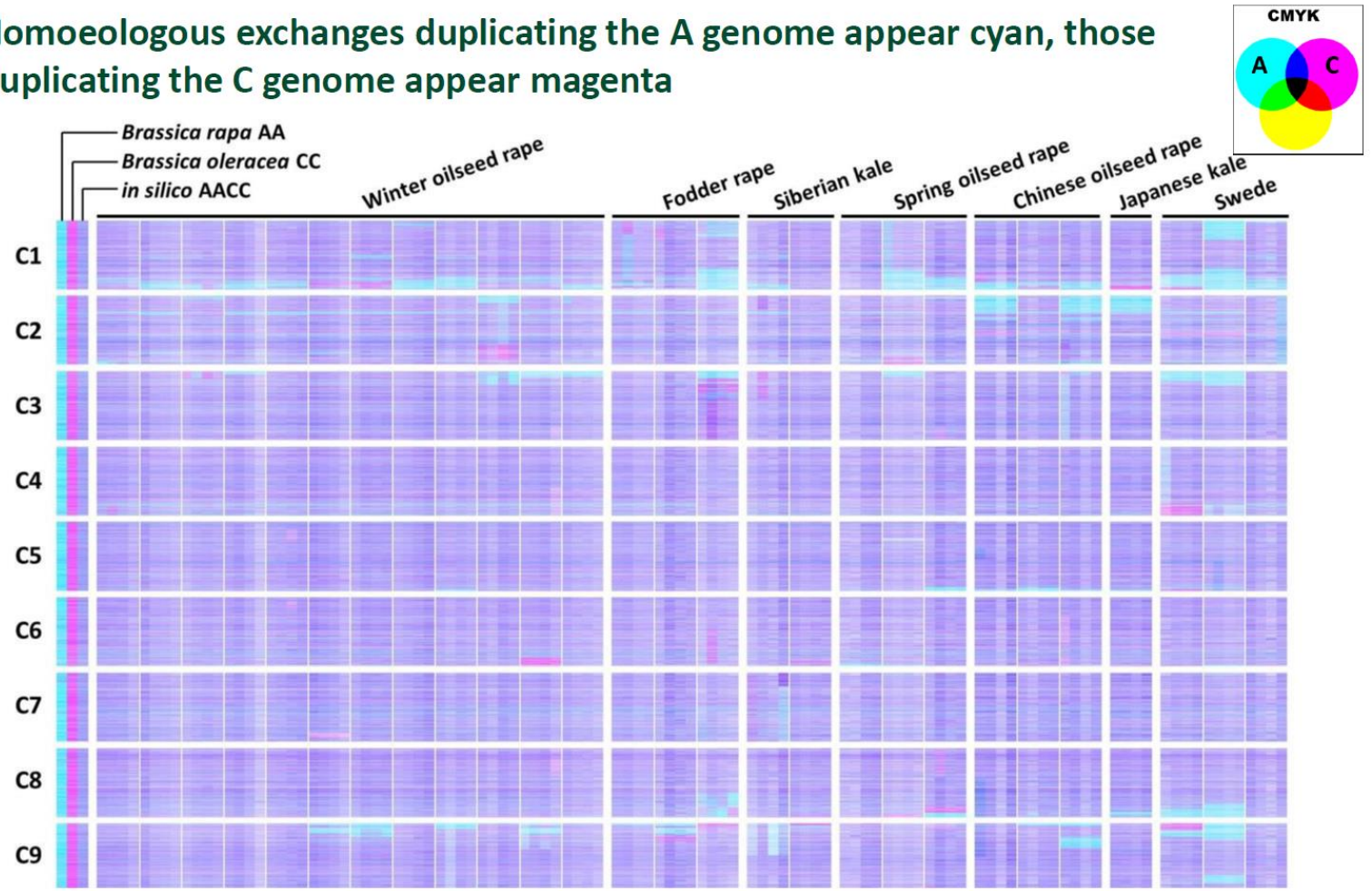
Cultivars have their own microbiomes each.

high microbial diversity suppresses pathogens → plants can exploit microbial consortia from soil for protection

breeding can hamper possibilities for positive BCA interaction

## Assessment of a panel of *B. napus* varieties by mRNAseq

**Homoeologous exchanges duplicating the A genome appear cyan, those duplicating the C genome appear magenta**




Ian Bancroft 22nd May, 2019

UNIVERSITY of York

# What do we think is important for clubroot research in the future

Conditions more close to field tests
Field soil testing if only greenhouse trials are possible

Testing of more canola cultivars with more *P. brassicae* isolates should be made

Identification of current clubroot differential sets that are active in soils right now
→ timely testing of isolates

Easier (faster) access to genome/transcriptome data

More collaboration possibilities between remote labs

# Thanks to:


collaborations:

Bretislav Brzobohaty, Martin Cerny
Mendel University, CZ

Mendelova univerzita v Brně

## Funding:

Bundesministerium für Ernährung und Landwirtschaft

Bundesministerium für Bildung und Forschung

BAYER

Freistaat SACHSEN

Europa fördert Sachsen. ESF Europäischer Sozialfonds

DAAD

ERA IB European Research Area Industrial Biotechnology