Interactions of *Solanum* spp. with pectinolytic bacteria

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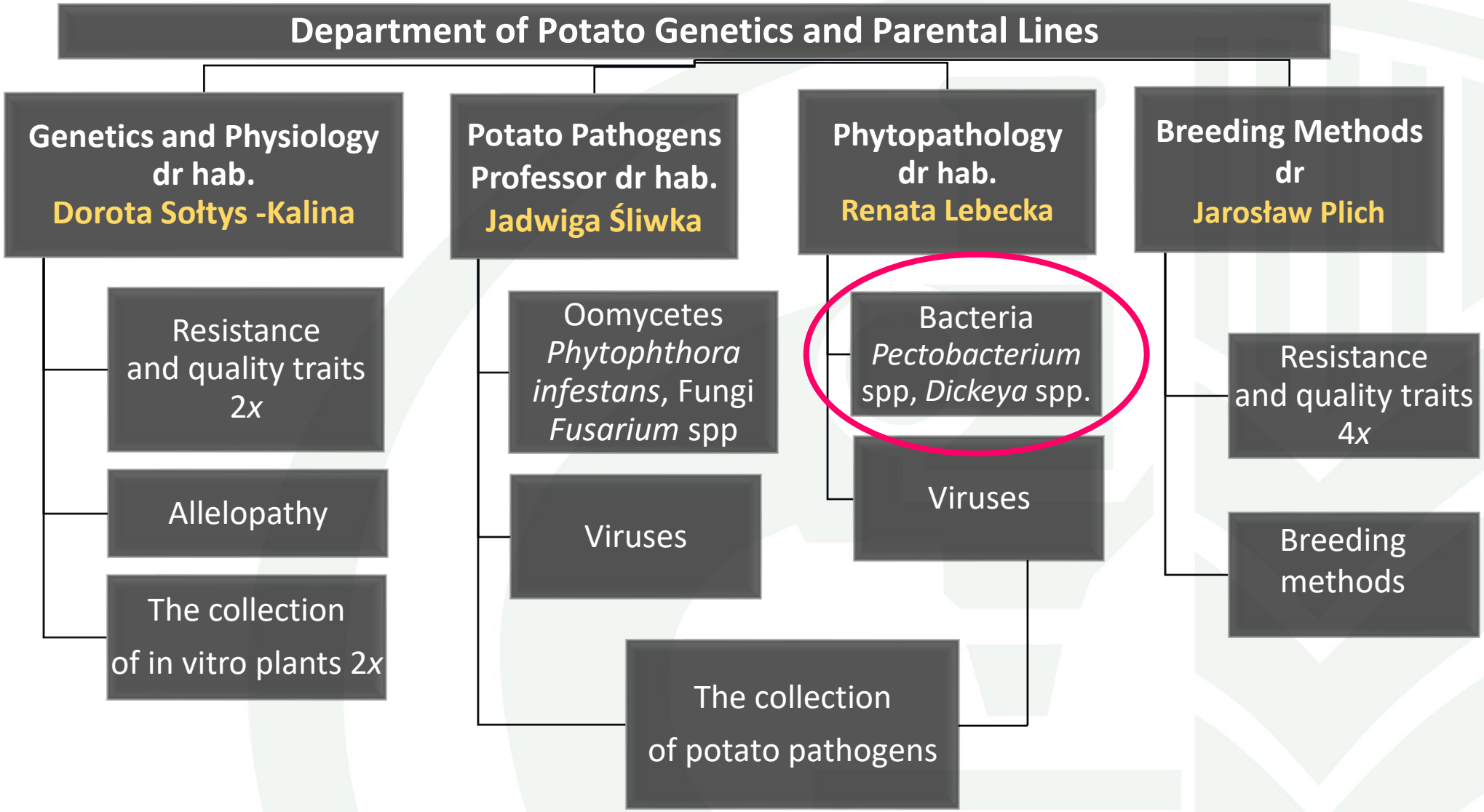
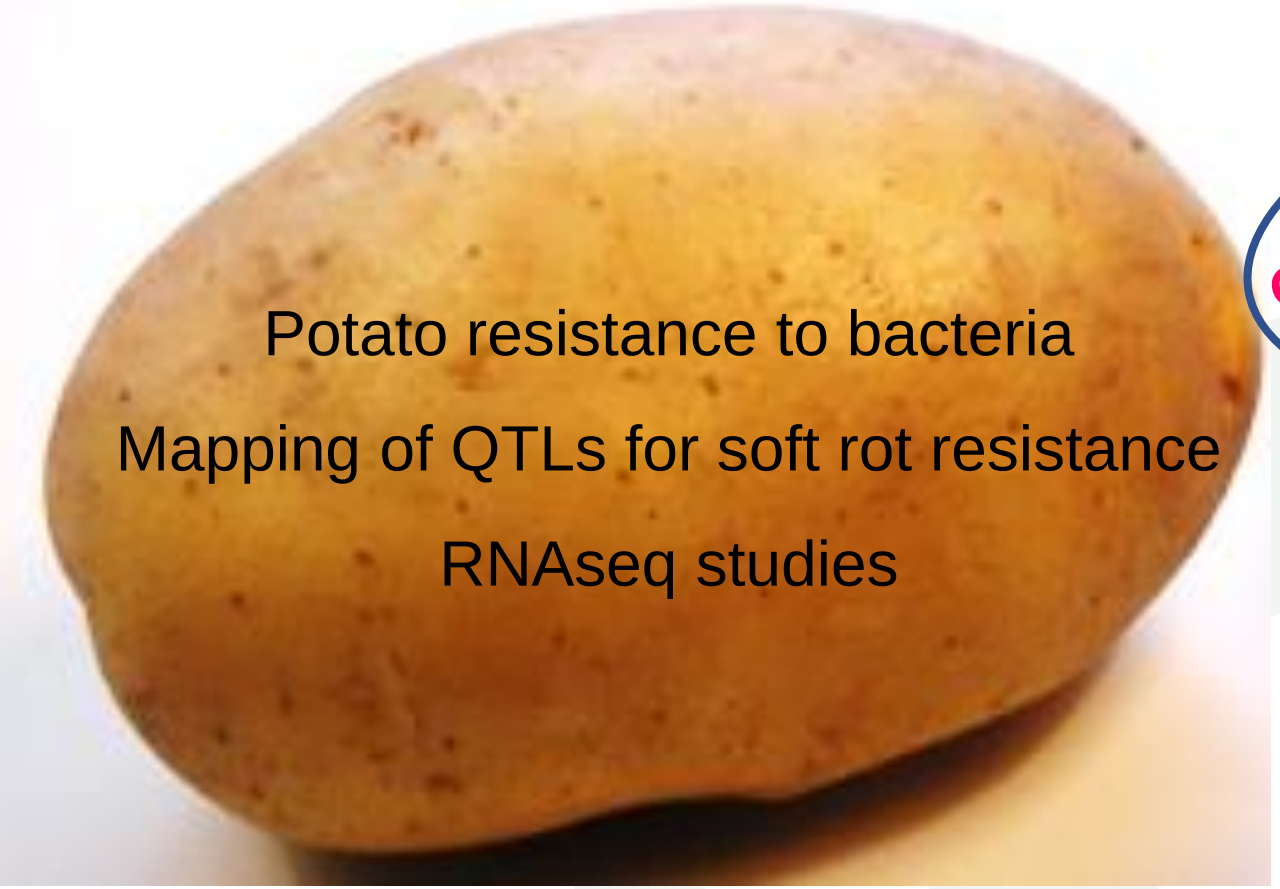

Department of Potato Genetics and Parental Lines
Genetics and Physiology dr hab. Dorota Sołtys -Kalina
Resistance and quality traits 2x
Allelopathy
The collection of in vitro plants 2x
Potato Pathogens Professor dr hab. Jadwiga Śliwka
Oomycetes Phytophthora infestans, Fungi Fusarium spp
Viruses
Phytopathology dr hab. Renata Lebecka
Bacteria Pectobacterium spp, Dickeya spp.
Viruses
The collection of potato pathogens
Breeding Methods dr Jarosław Plich
Resistance and quality traits 4x
Breeding methods



Potato resistance to bacteria

Mapping of QTLs for soft rot resistance

RNAseq studies

Pectinolytic bacteria

Glycoalkaloids from Solanum spp.

Virulence of bacteria

Introduction

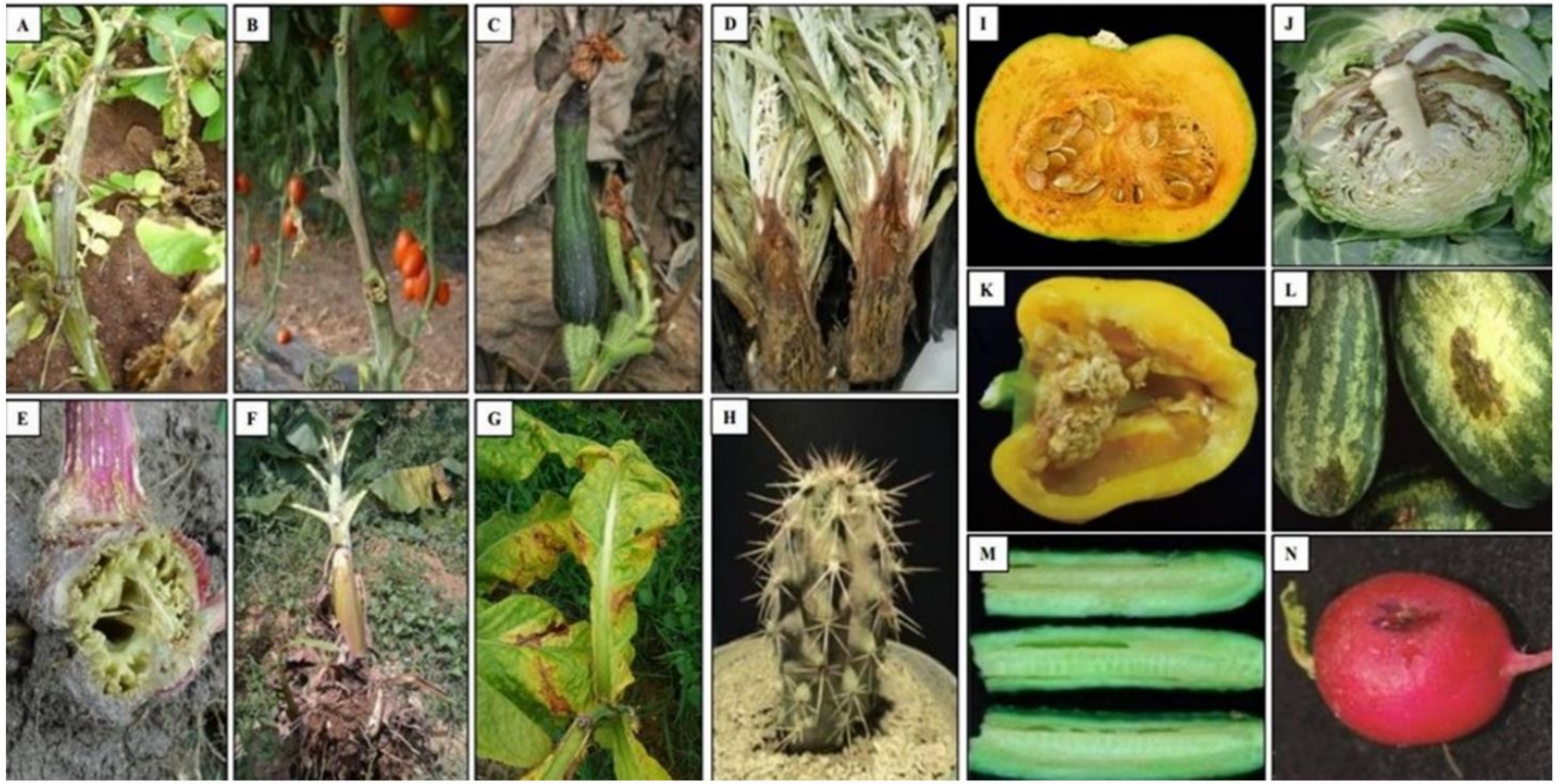
Order: *Enterobacteriales*

Family: *Pectobacteriaceae*

Genus: ***Dickeya*, *Pectobacterium***

21 species of *Pectobacterium*

12 species of *Dickeya*

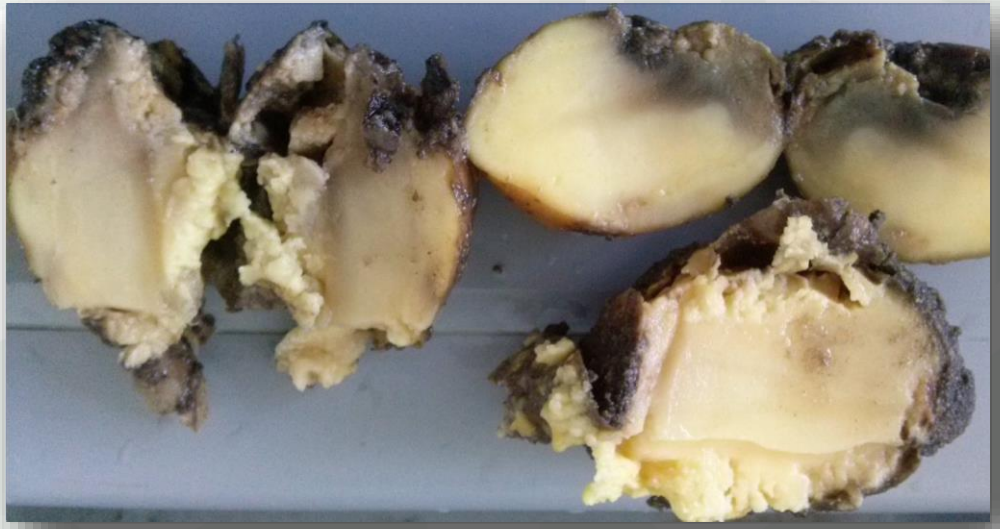


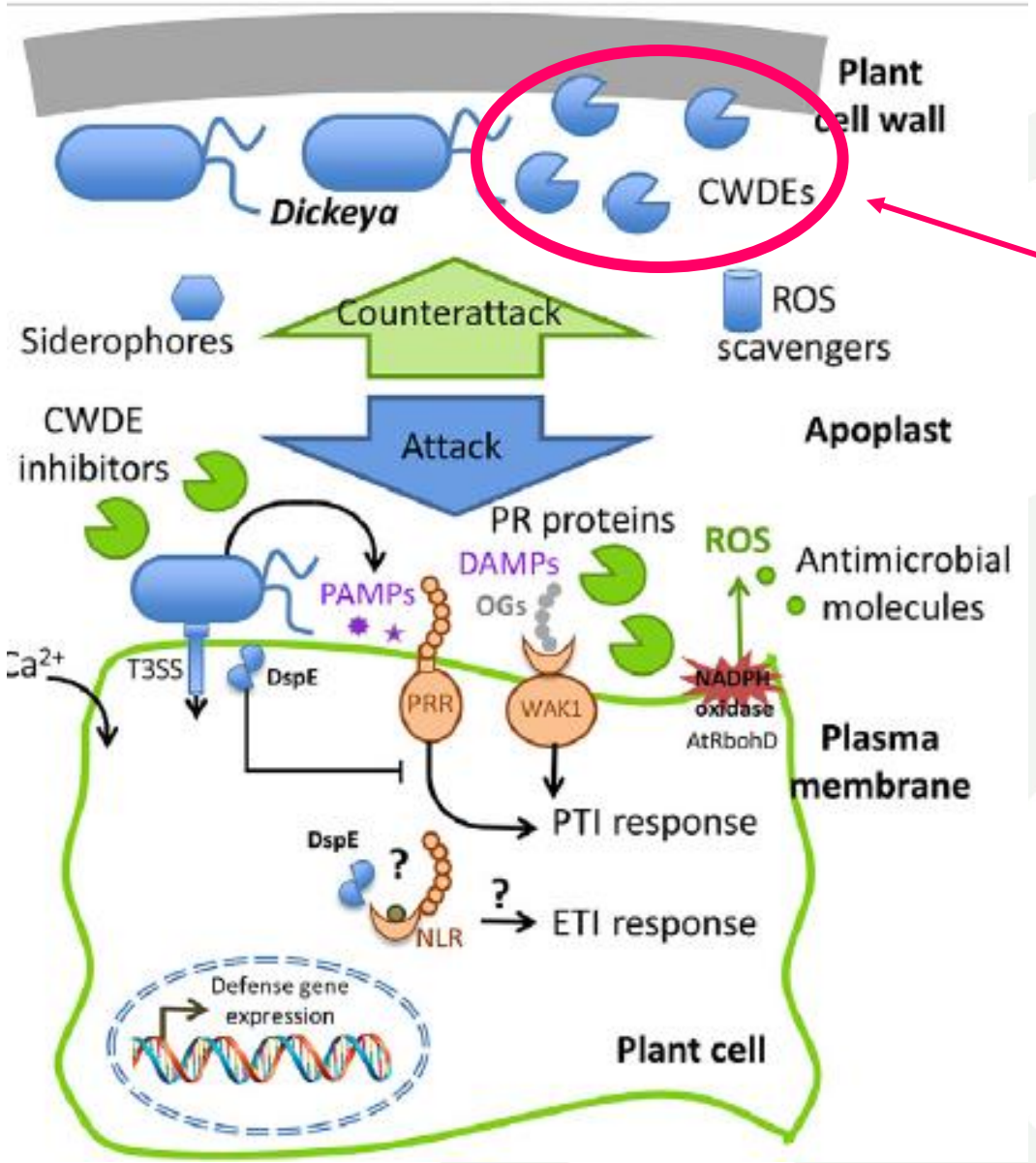
Oulghazi et al. 2021. Microorganisms 9, 106.

The most threatening of phytopathogens to the health of vegetable, ornamental and fruit crops.

Blackleg

Soft rot





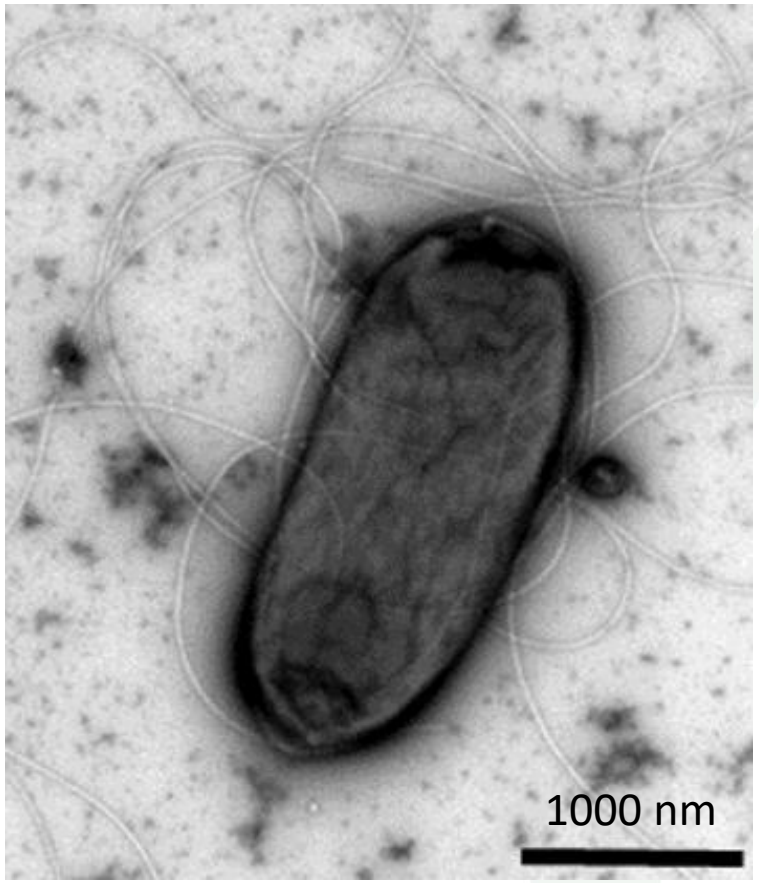
Reverchon et al. 2016

Virulence factors – Quorum Sensing

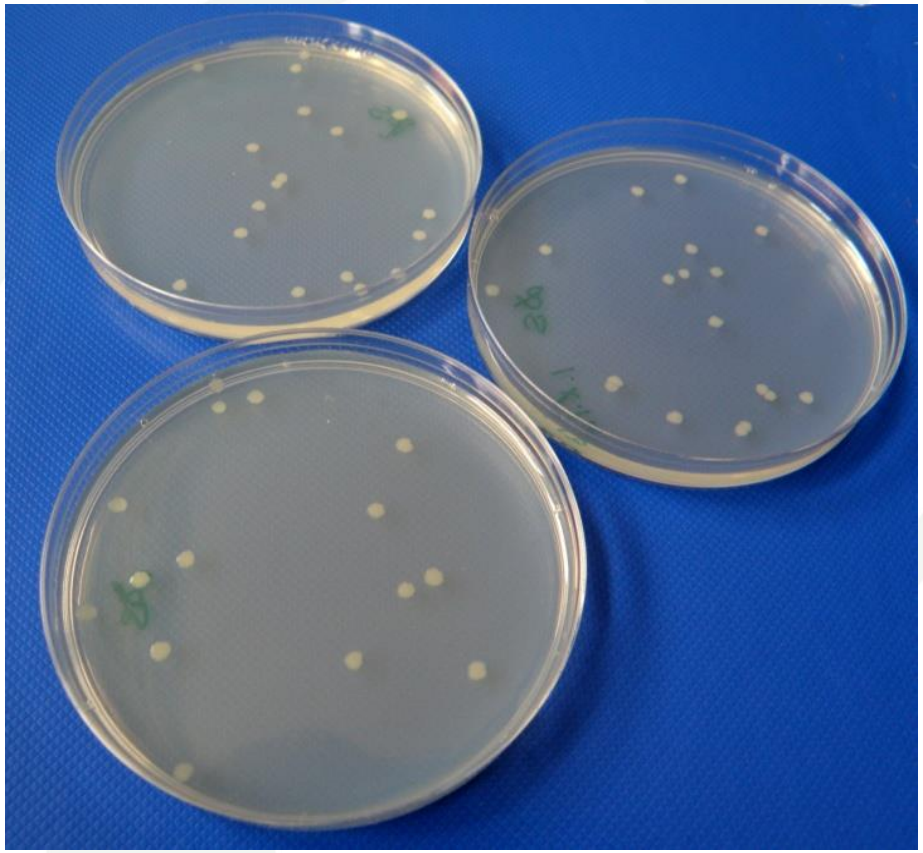
Vfm and ExpI-ExpR

- Pectin Cell Wall Degrading Enzymes,
- Motility,
- Biofilm formation,
- Siderophores,
- ROS scavengers.

Dickeya solani

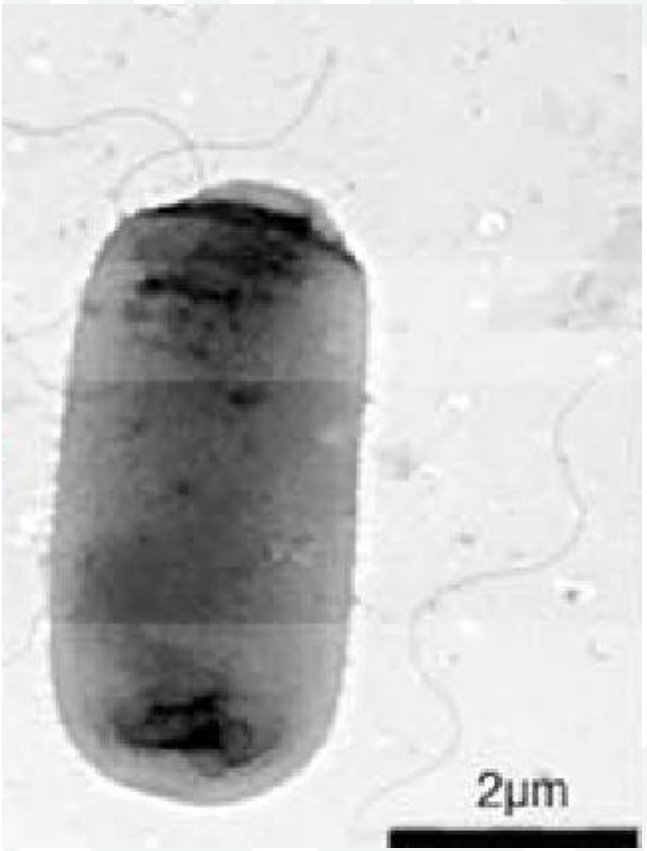


Lisicka et al. 2018.
Front. Plant Sci. 9:374



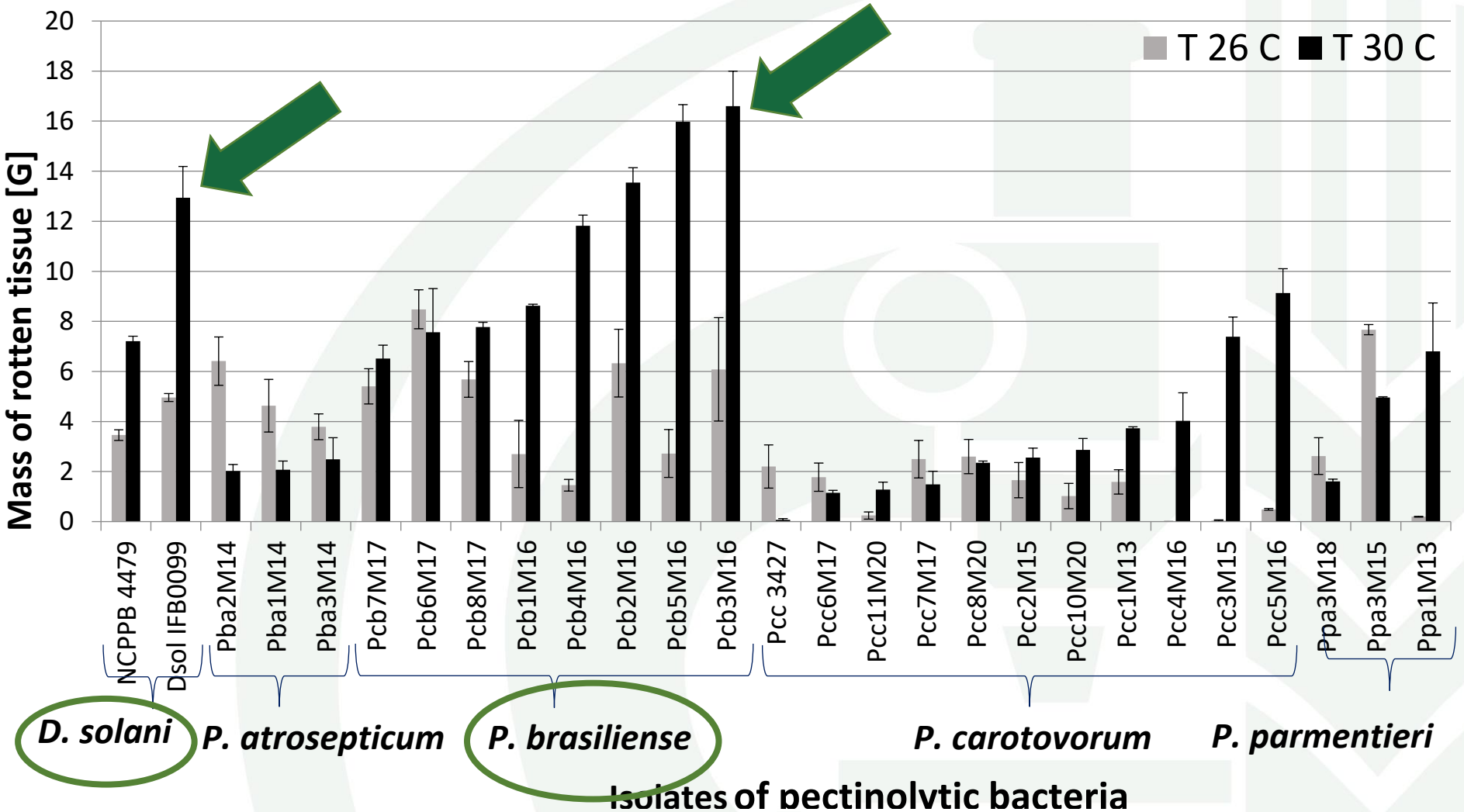
D. solani IFB0099

Pectobacterium brasiliense



Moleleki et al. 2017.
Molecular Plant Pathology 18: 32–44

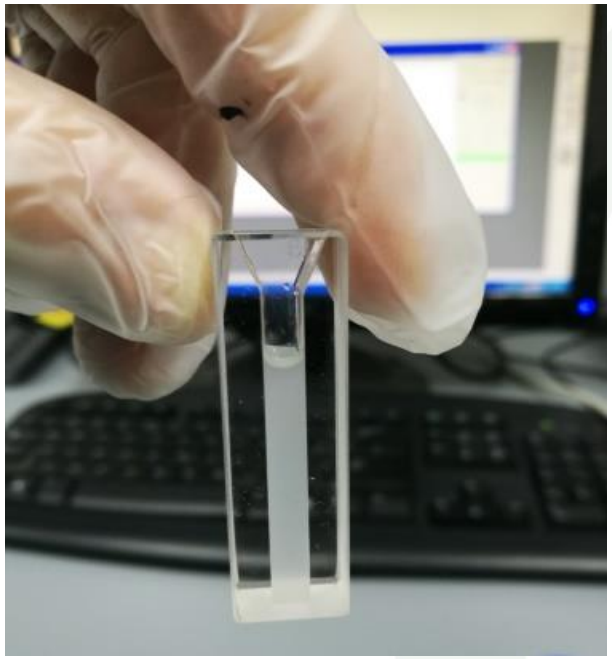
Aggressiveness of bacteria to potato tuber



Lebecka R. i Michalak K. 2020. **Ziemniak Polski** 4: 33-39

Methods

Bacterial inoculum*: Dickeya solani* IFB0099 OD_{600} = 1.0, 10^9 CFU mL^{-1}, 10 µL



(Lebecka R., 2001)

11

Cultivar Irys

Lady Claire

Lady Rosetta

Highly susceptible ⟷ Medium resistant

DS - the disease severity - the mean weight of macerated tissue

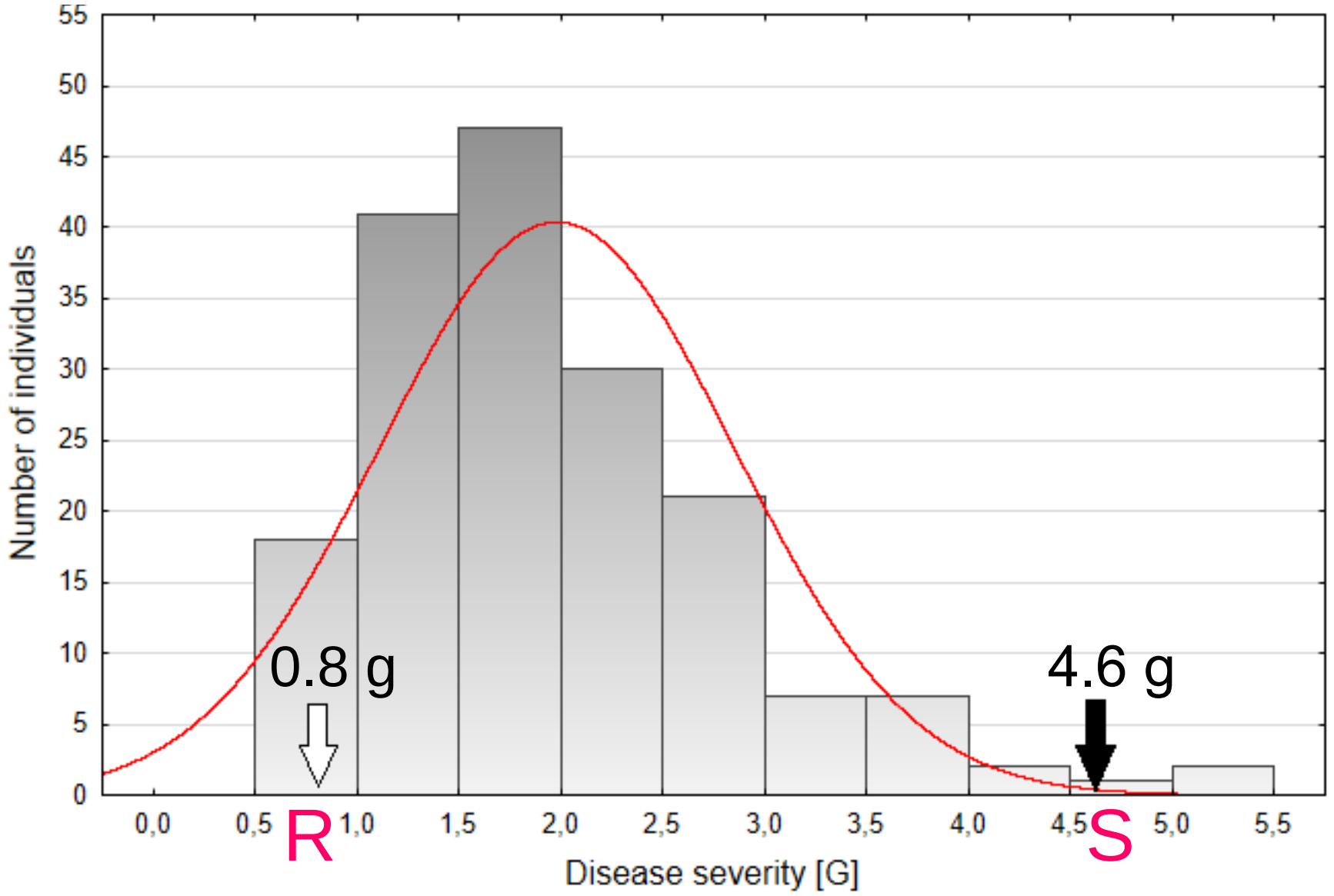
DI - the disease incidence - the proportion of tubers with rot symptoms

Reaction of potato tubers to inoculation with bacteria *D. solani*

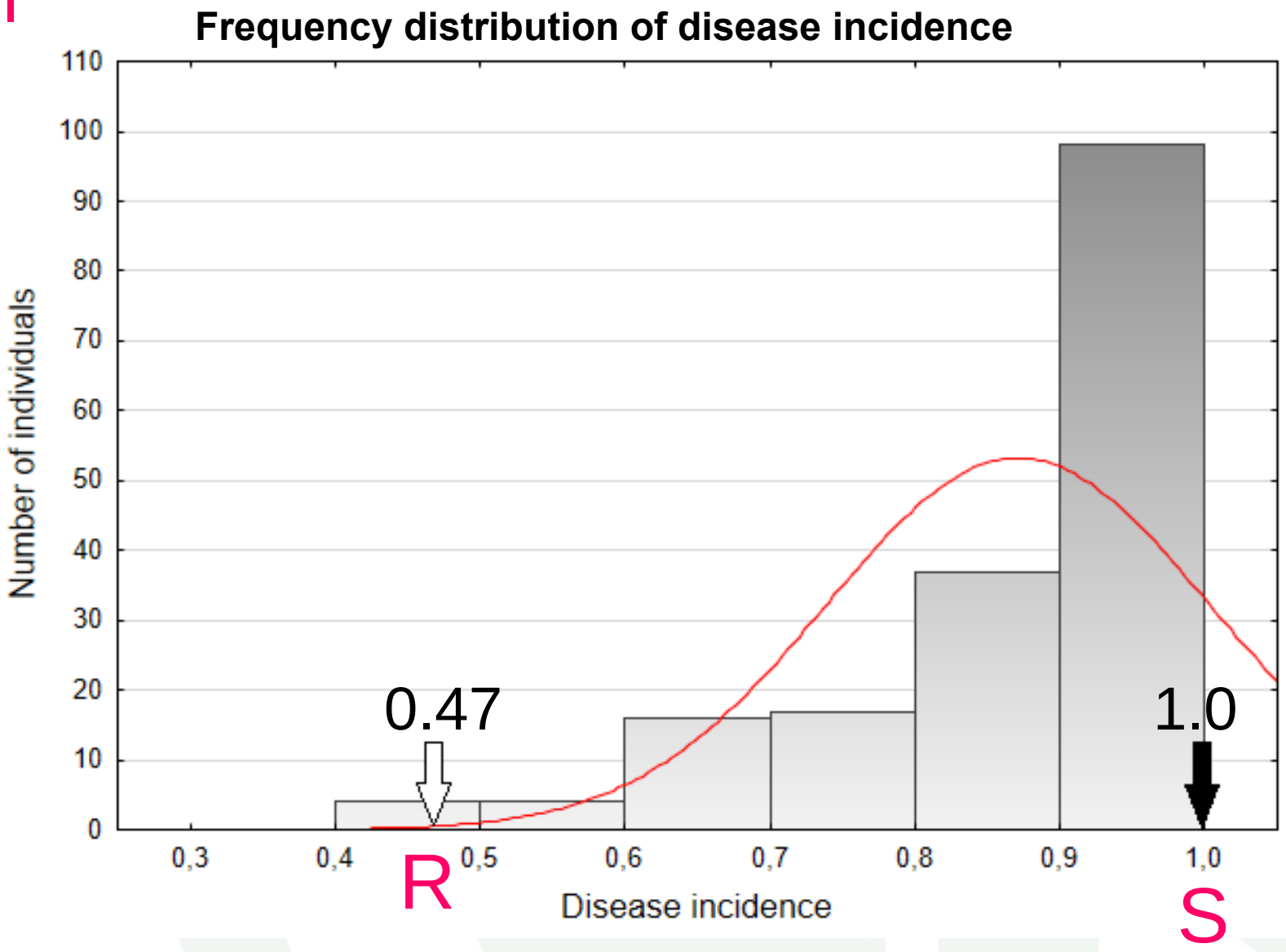
in the highly resistant parent DG 00-270 (**R**) and susceptible parent DG 08-305 (**S**)

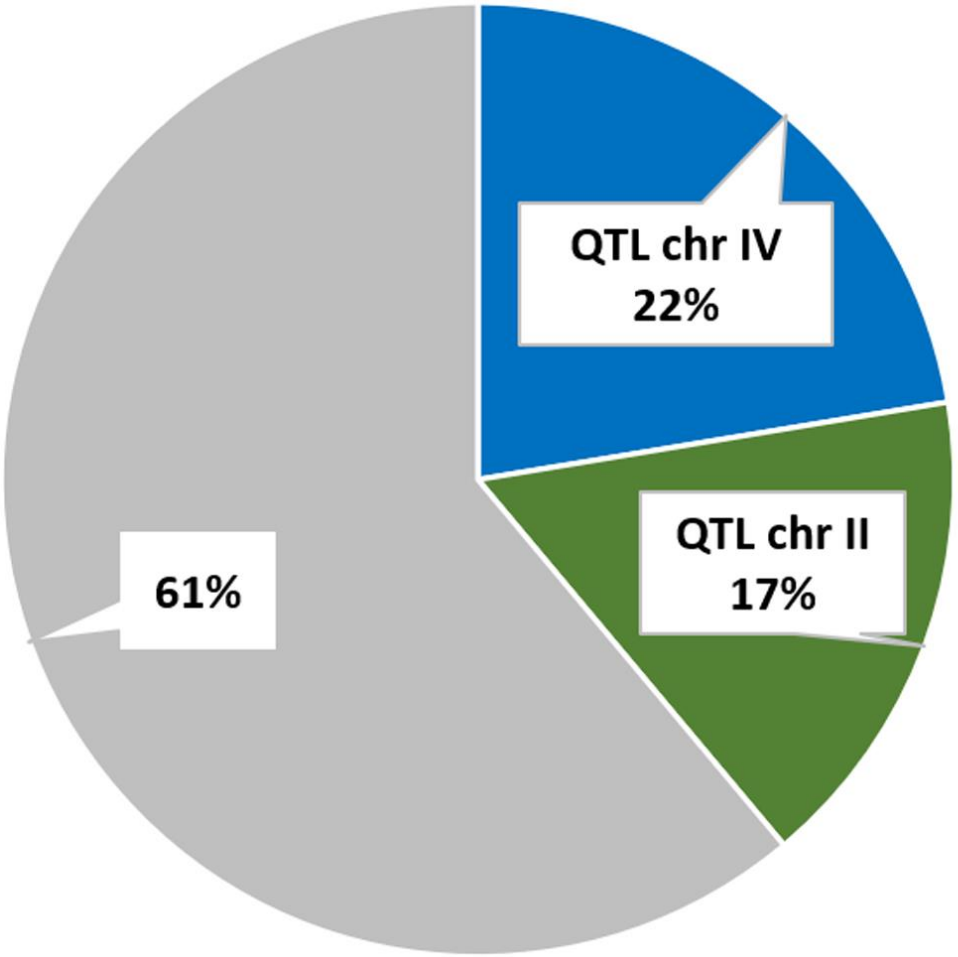
DS

Frequency distribution of disease severity



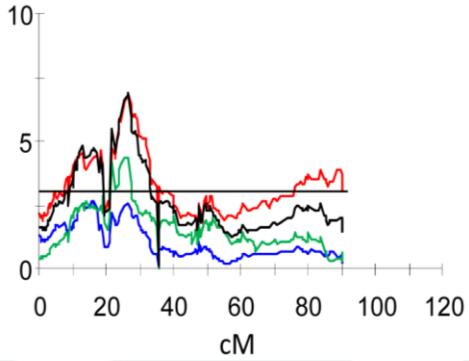
DI


Frequency distribution of disease incidence
Number of individuals
110
100
90
80
70
60
50
40
30
20
10
0
0,3
0,4
0,5
0,6
0,7
0,8
0,9
1,0
Disease incidence
0.47
1.0
R
S

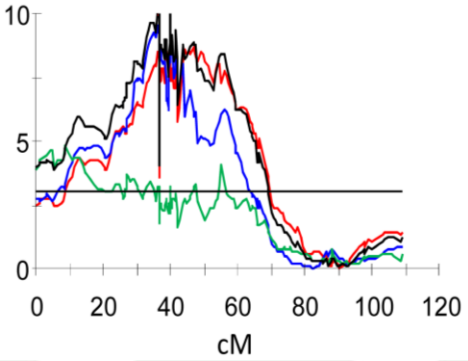


QTL for disease severity

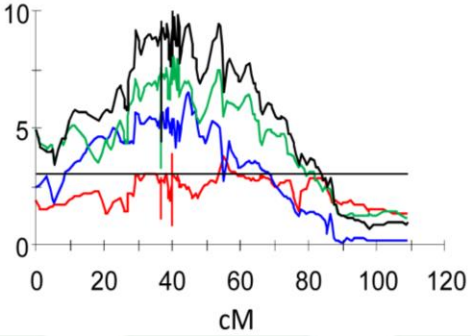
Chromosome II



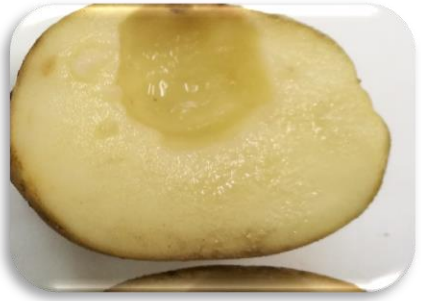
Chromosome IV

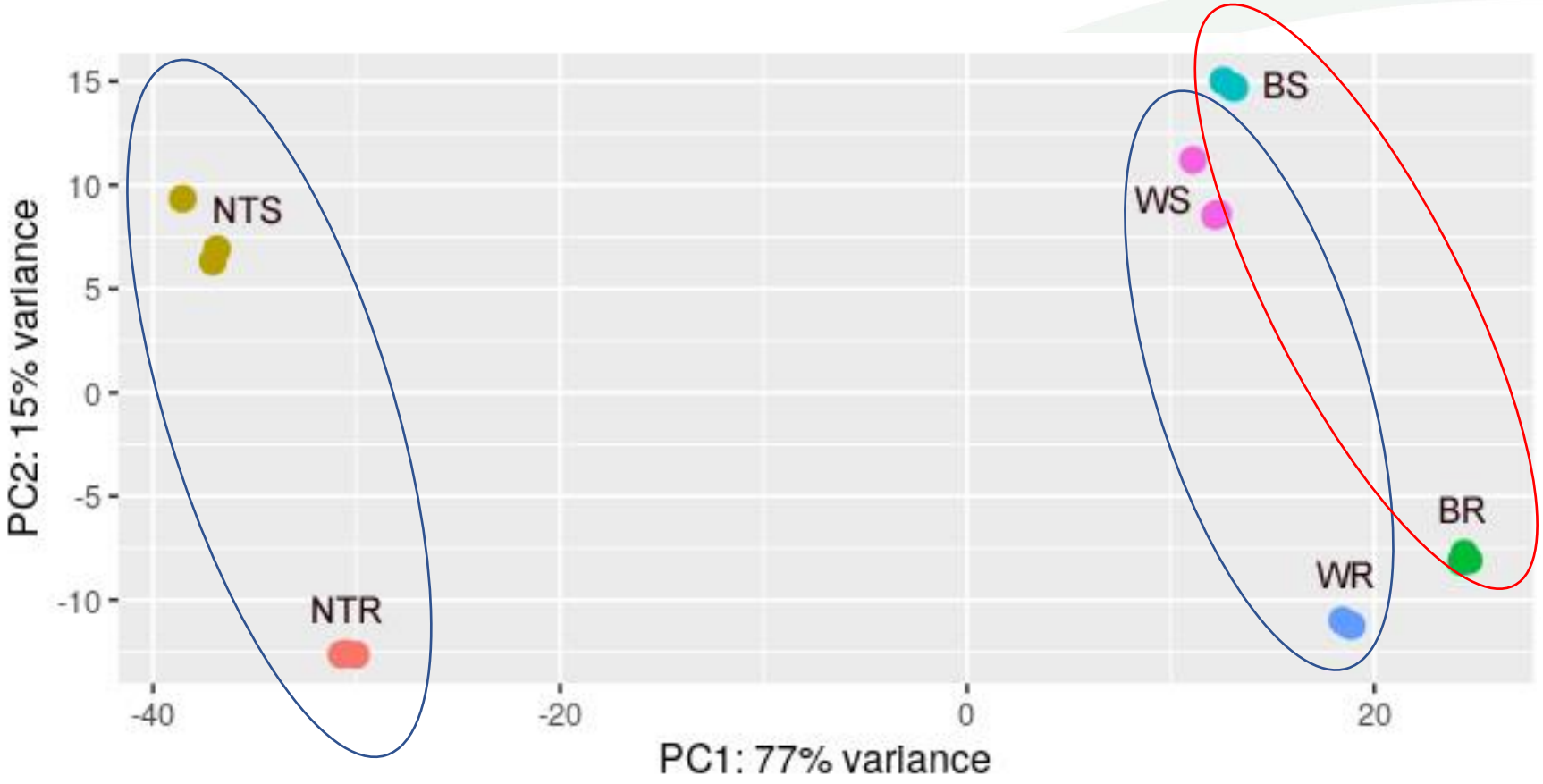


QTL for disease incidence



Lebecka et al. 2021.**Plant Pathology**. 2021, 70 (7) 1745-1756.

	Not treated	Wounded + Water	Wounded + Bacteria
Resistant individuals (5) 	NTR	WR	BR
Susceptible individuals (5) 	NTS	WS	BS



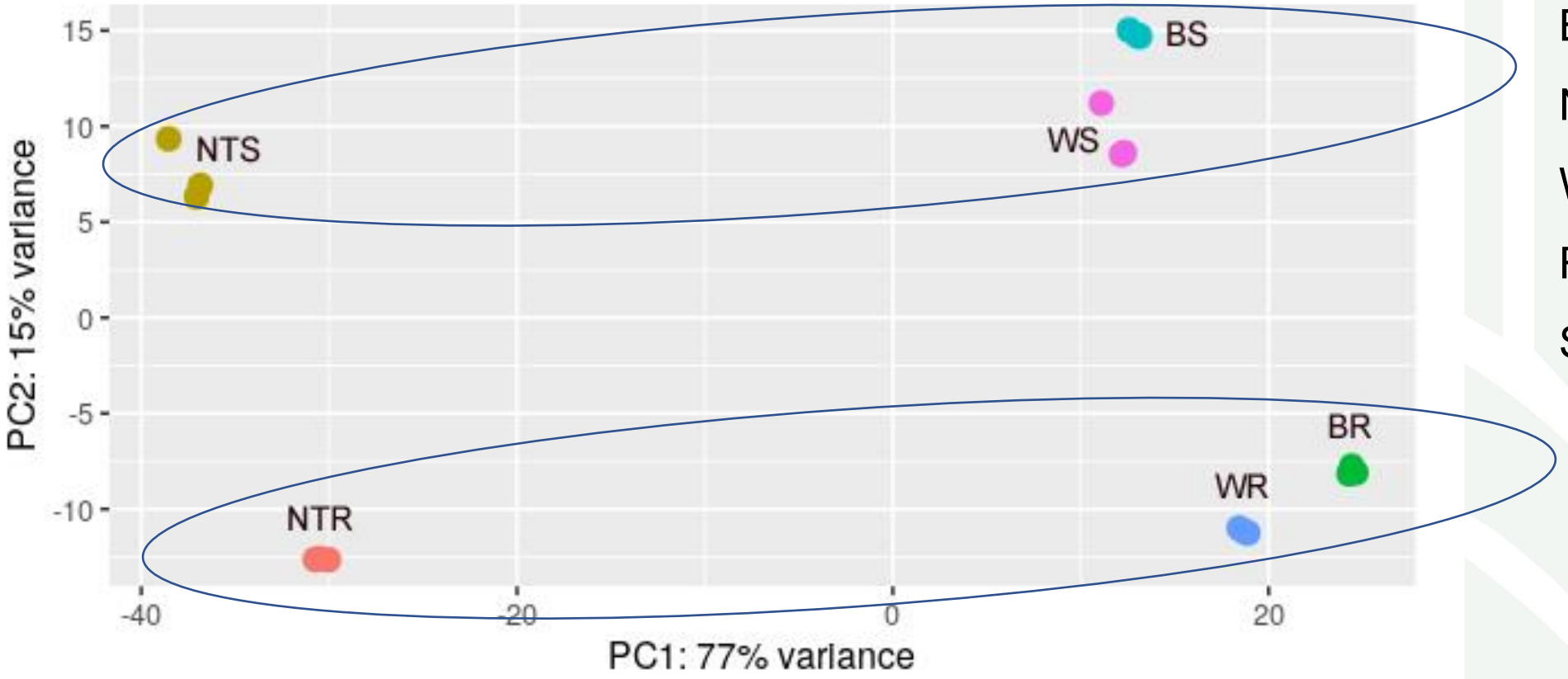
B – bacteria

NT – not treated

W – water

R – resistant

S – susceptible



B – bacteria

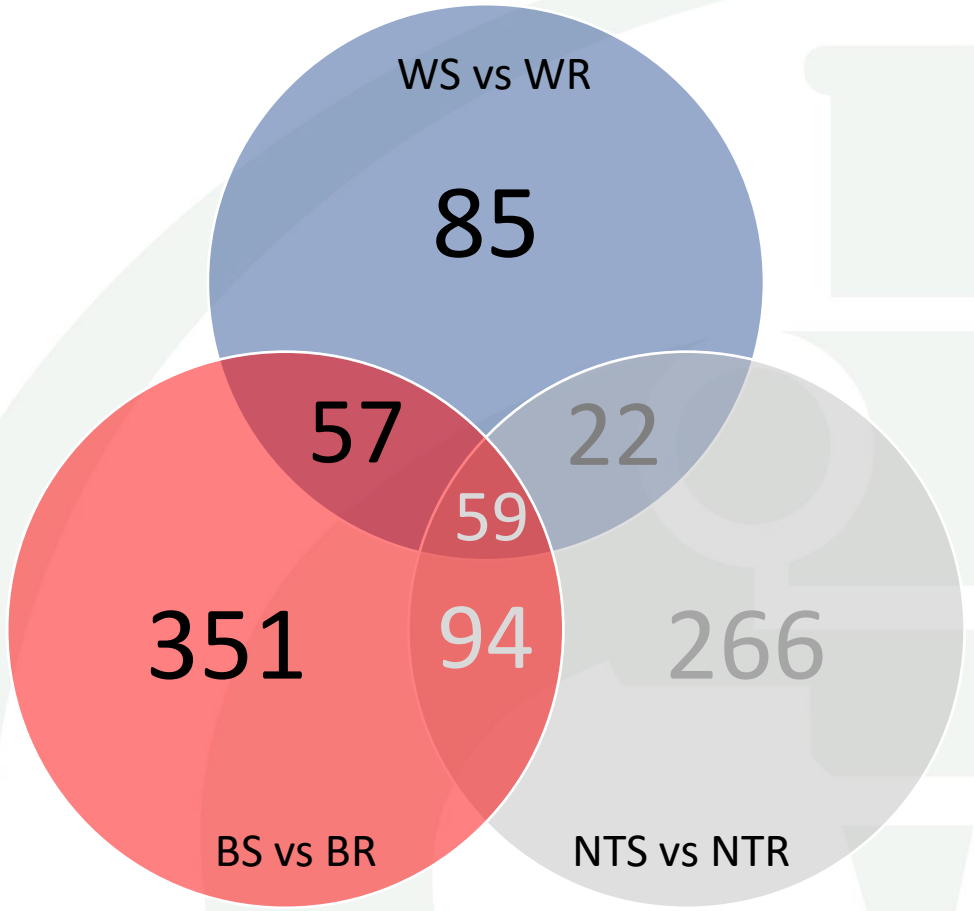
NT – not treated

W – water

R – resistant

S – susceptible

Number of genes
upregulated



(fold change $lg_2 \geq 2.0$; $p \leq 0.05$)

Candidate genes

12 genes

- stress response,
- resistance to bacteria,
- pathogenesis related,
- resistance genes,
- defense mechanisms,
- pathogen recognition,
- wound healing

(Fold Change from 4 – 96)

13 genes

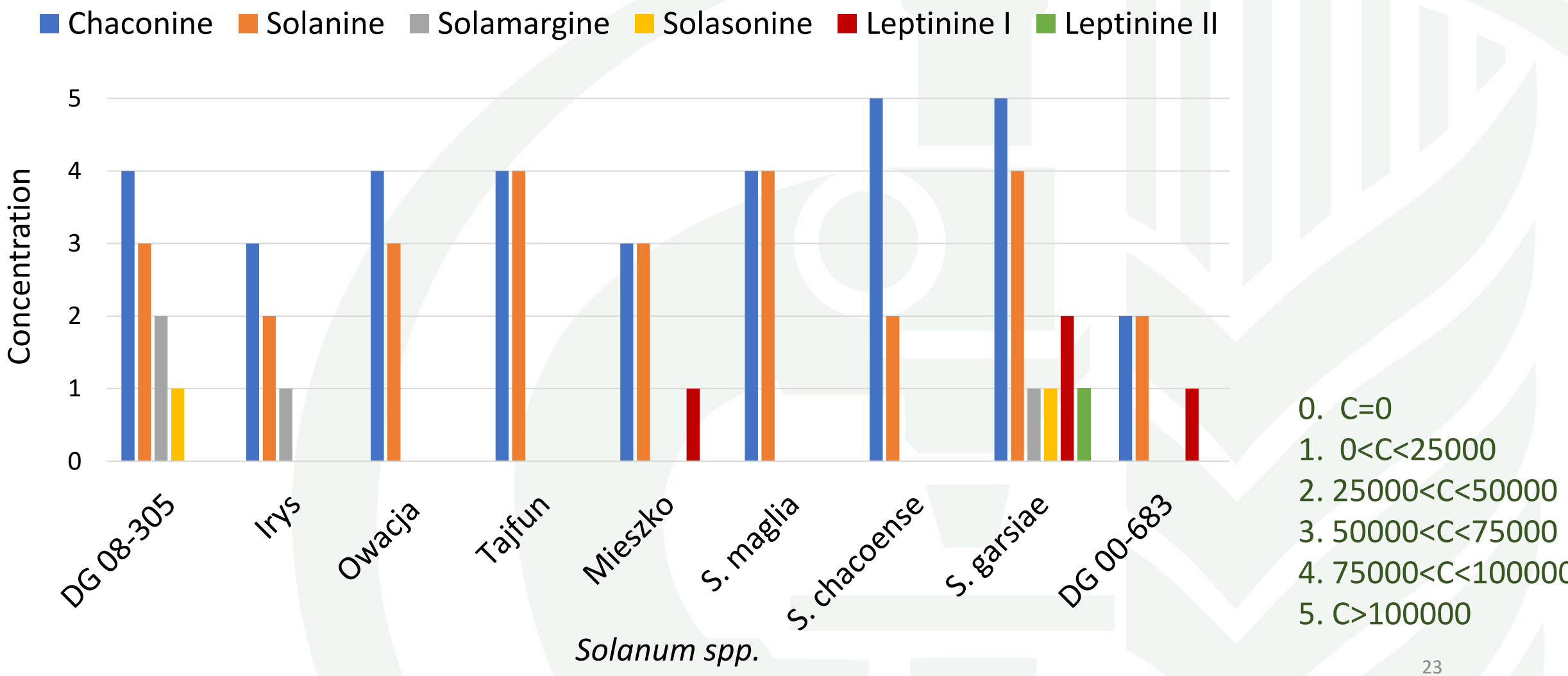
- Peroxidases (5 only BR)
- ferluloyl Co-A,
- cytochrom P450

(Fold Change from 2 - 9)

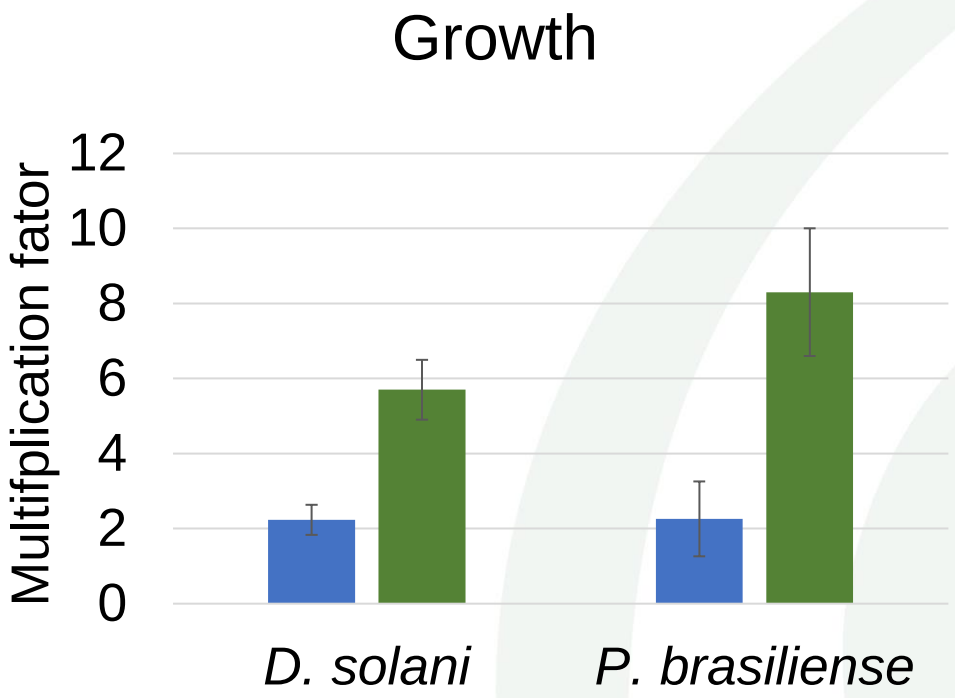
Take home message:

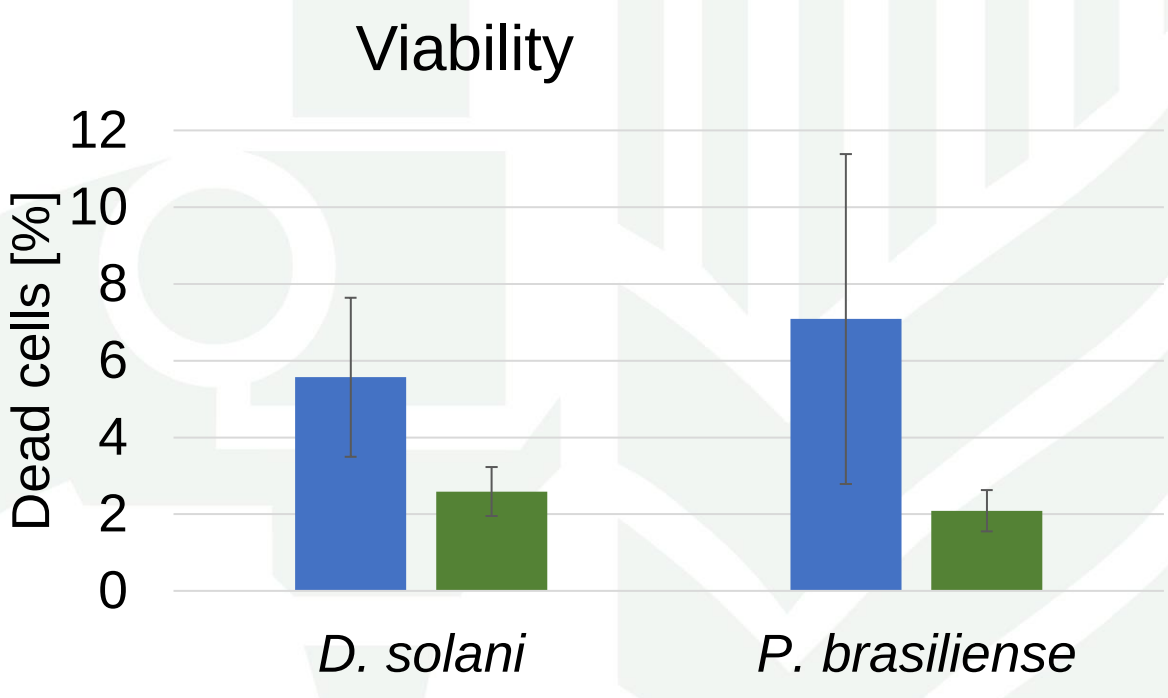
- Pectinolytic bacteria are brute-force pathogen with sofisticated systems of virulence.
- Bacteria can live in tubers/plants in latent forms, waitng for favorable conditions to start infection.
- There is no extreme resistance in potato.
- The highest resistance was found in hybrids originated from wild *Solanum* species, identified QTLs explain 39% of total variance.

The relative content of glycoalkaloids in leaves of *Solanum* spp. plants



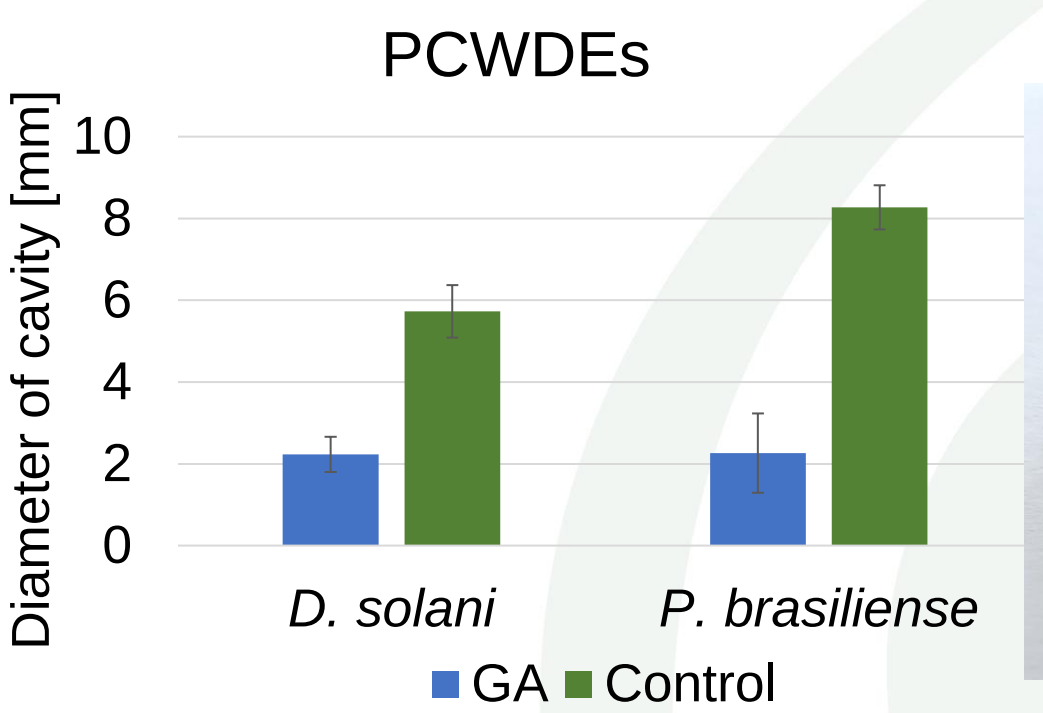
Bacterial growth and viability in LB medium with glycoalkaloids from leaves of different *Solanum* spp.



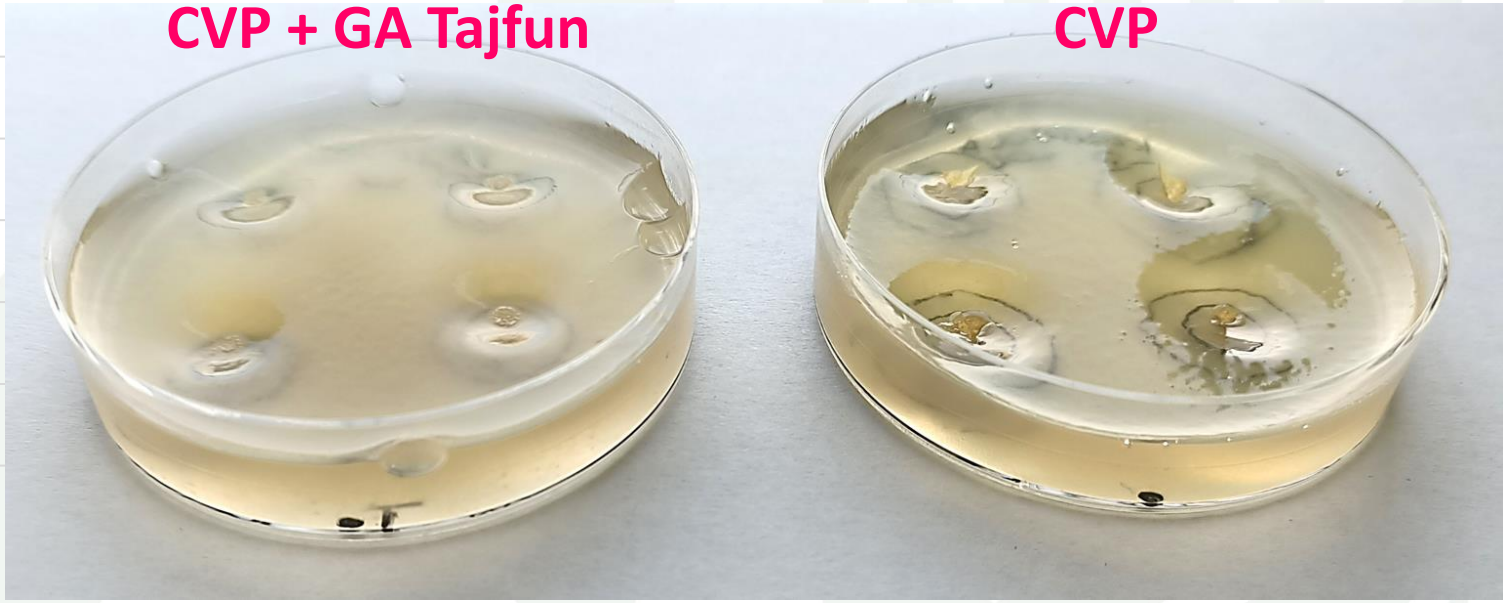


GA Control

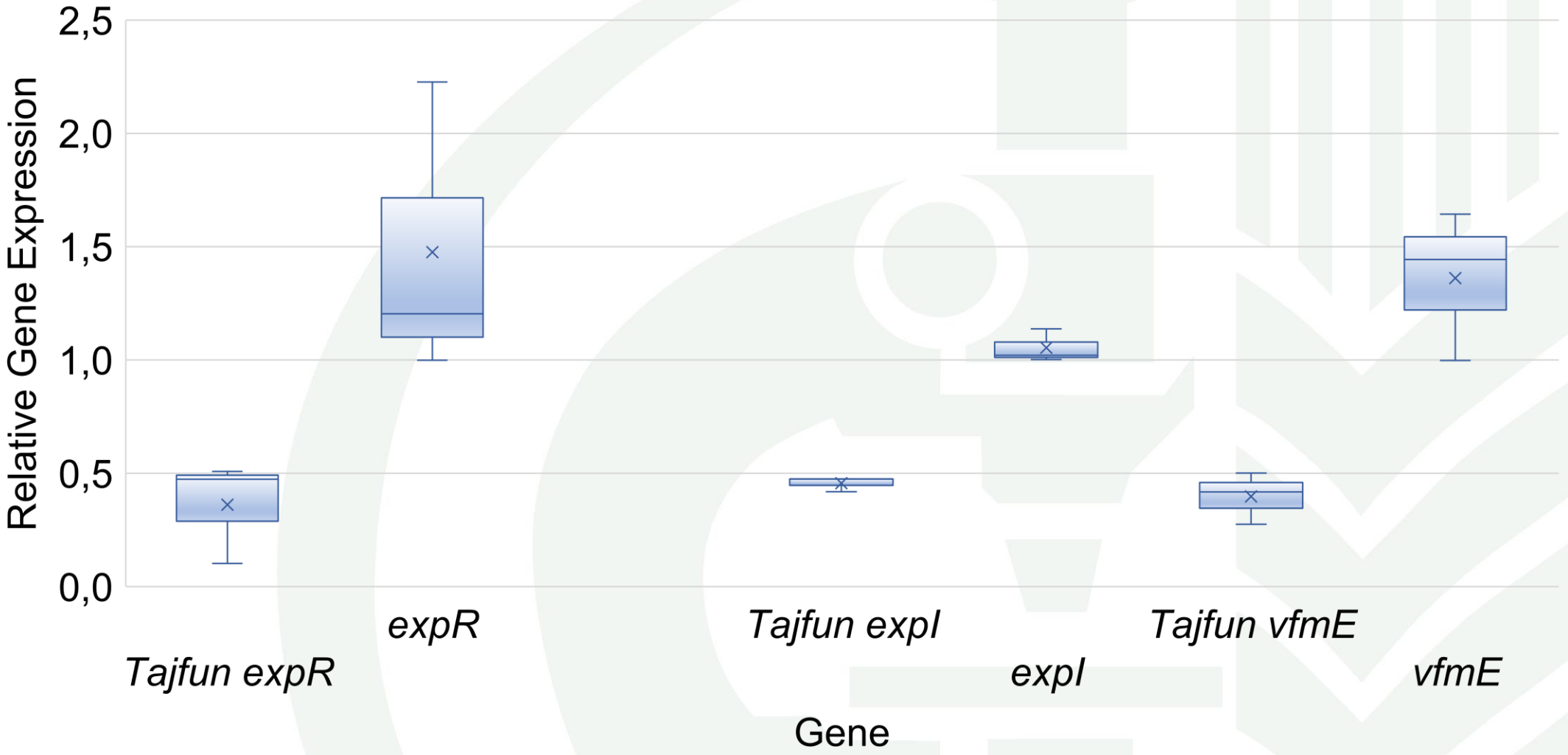
Pectinolytic activity of bacteria in Pectate medium with glycoalkaloids from leaves of *Solanum* spp



Dickeya solani



Gene expression in ***D. solani*** incubated in LB medium with glycoalkaloids from leaves of cv. Tajfun



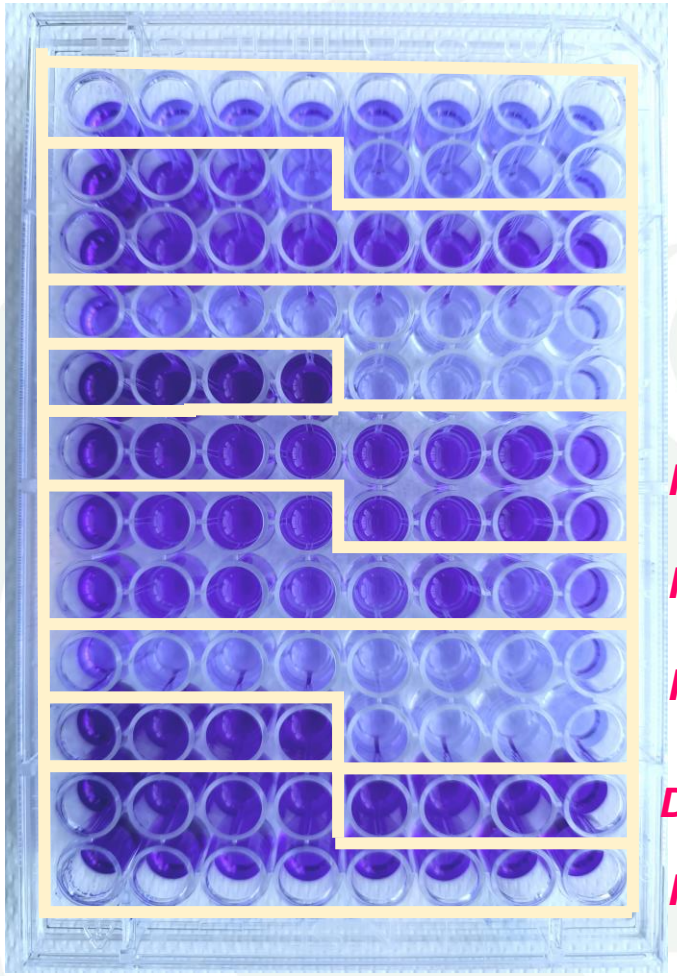
Biofilm formation with glycoalkaloids from leaves of *Solanum* spp

Ds + GA Tajfun

Ds + GA *S. chacoense*

Ds + GA DG 00-683

Ds Control



Ds Control

Pbra + GA Tajfun

Pbra + GA *S. chacoense*

Pbra + GA DG 00-683

Ds Control

Pbra Control

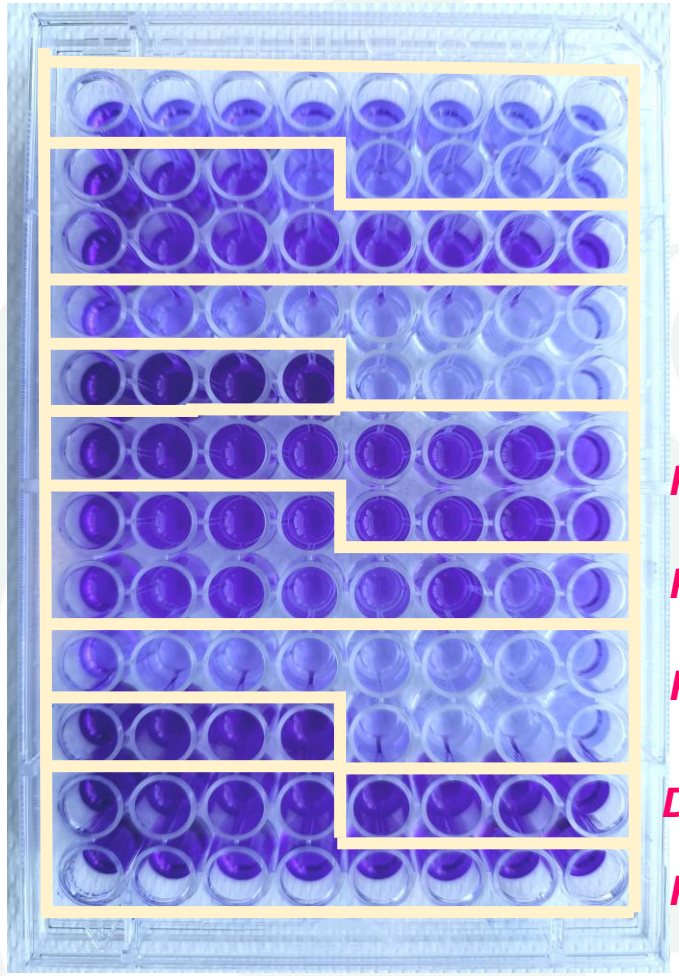
Biofilm formation with glycoalkaloids from leaves of *Solanum* spp

Ds + GA Tajfun

Ds + GA *S. chacoense*

Ds + GA DG 00-683

Ds Kontrola



Pbra + GA Tajfun

Pbra + GA *S. chacoense*

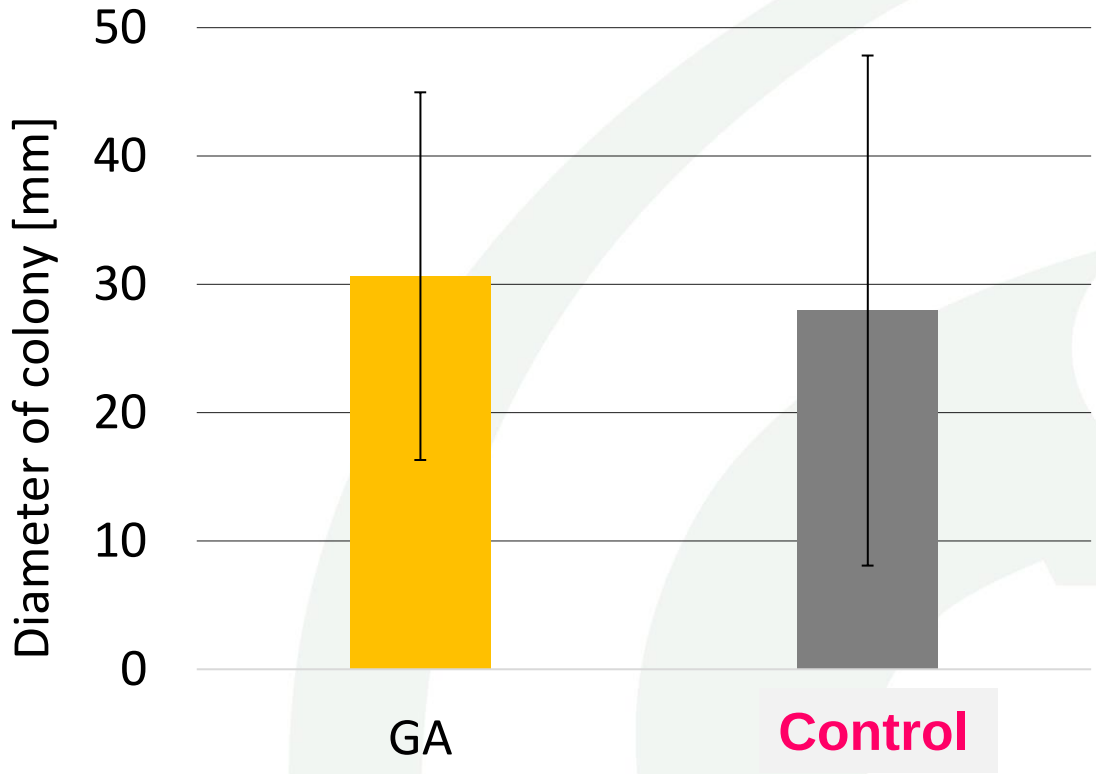
Pbra + GA DG 00-683

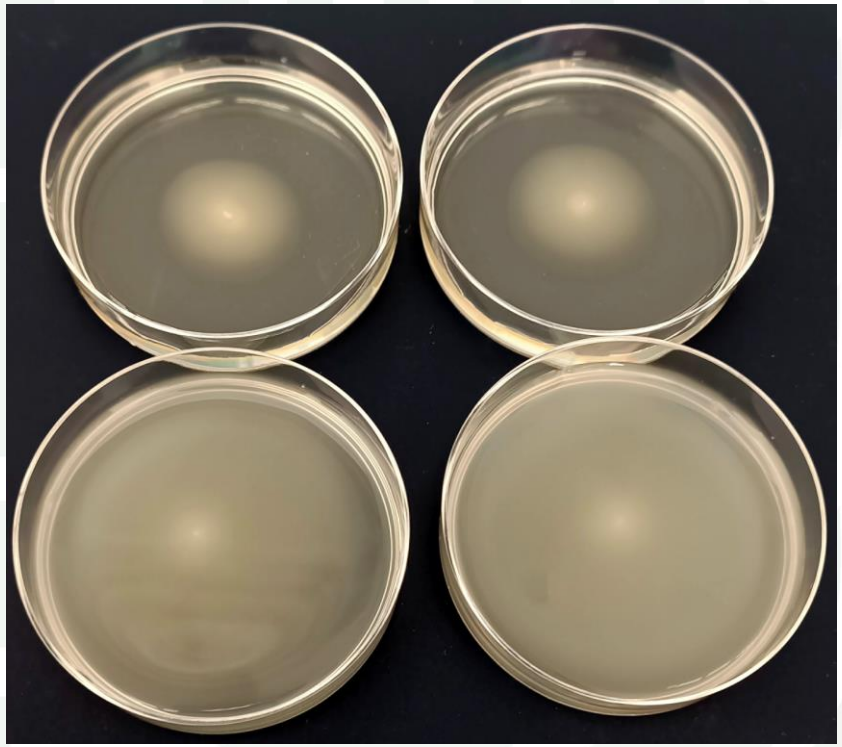
Ds Kontrola

Pbra Kontrola

Ds Kontrola

Swimming of bacteria *D. solani* and *P. brasiliense* with glycoalkaloids from leaves of *Solanum* spp plants, in Luria Berthani 2.5% agar medium

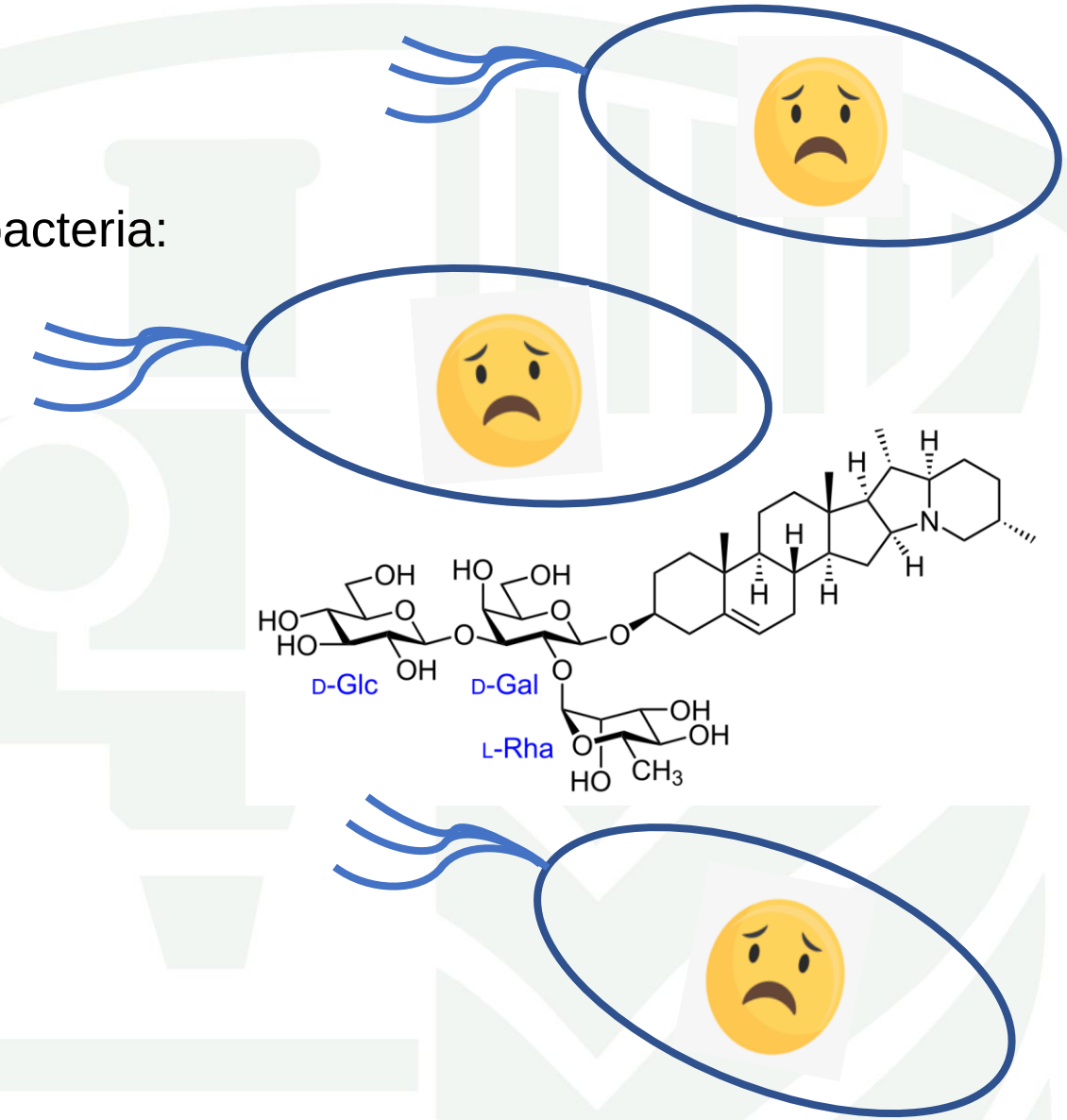




GA from cv. Tajfun, *S. chacoense* and DG 00-683

Take home message:

- **Glycoalkaloids** reduce the virulence of pectinolytic bacteria:
  - bacterial growth
  - pectinolytic activity
  - biofilm formation
  - QS key regulators genes
  - but not motility



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Prof. dr hab. Jadwiga Śliwka
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Thank you for your attention

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microorganisms

MDPI

Article

Increase of Glycoalkaloid Content in Potato Tubers by Greening as a Method to Reduce the Spread of *Pectobacterium* and *Dickeya* spp. in Seed Production Systems

Dorota Sołtys-Kalina [1], Anna Grupa-Urbańska [1], Renata Lebecka [1], Maud Tallant [2], Isabelle Kellenberger [3] and Brice Dupuis [2,*]

Microorganisms **2023**, 11, 605.