Screening and modes of action of antagonistic bacteria to control two fungal pathogens, Phaeomoniella chlamydospora and Neofusicoccum parvum, involved in grapevine trunk diseases

Haidar Rana, Marc Fermaud

Screening and modes of action of antagonistic bacteria to control two fungal pathogens, *Phaeomoniella chlamydospora* and *Neofusicoccum parvum*, involved in grapevine trunk diseases

Haidar Rana

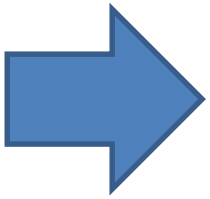
UMR Santé et Agroécologie du Vignoble (SAVE)
(INRA / Bordeaux Sciences Agro)

10th International Workshop on Grapevine Trunk Diseases – Reims 4-7 July 2017

Control methods

2001

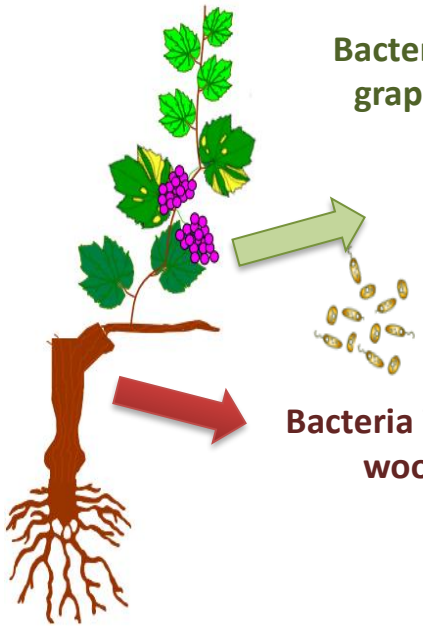
sodium arsenite



Control with biological control agents (BCAs)

No efficient strategies to control GTDs

Bacteria
as BCAs against GTDs



Bacteria isolated from grape berry surface

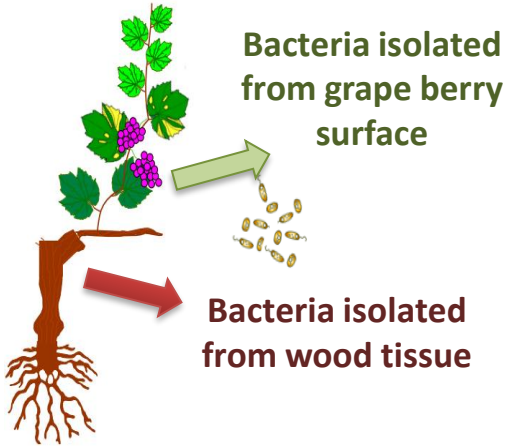
Martins et al., 2012

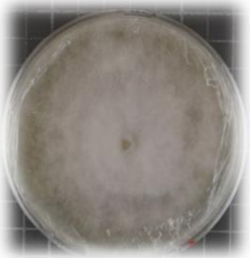
Bacteria isolated from wood tissue

Bruez et al., 2015

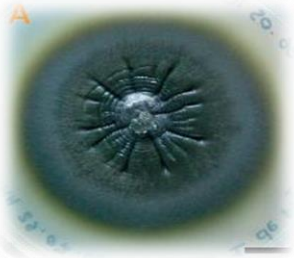
Objectives

Screening of efficient bacteria against Pch and Np





N. parvum (Np)



P. chlamydospora (pch)

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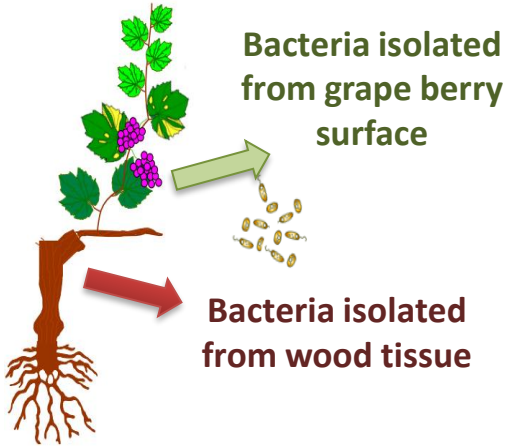

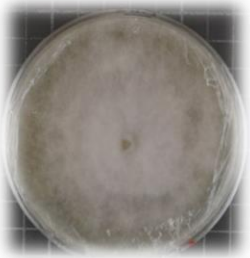

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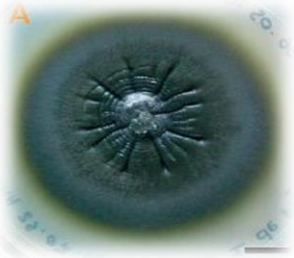

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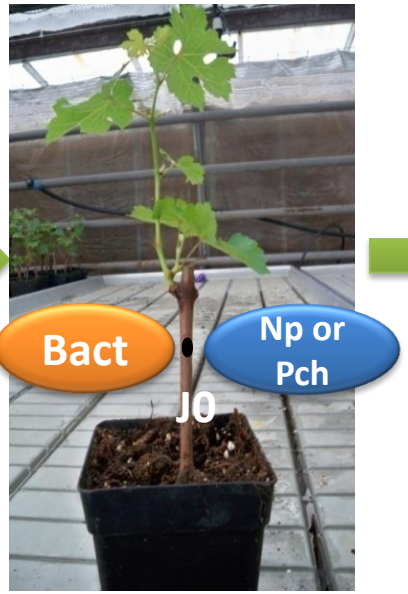
Experimental design :

Cabernet Sauvignon cuttings



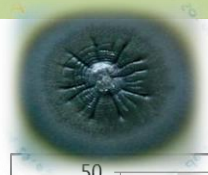
Bacteria/pathogen Co-inoculation

Incubation in open greenhouse

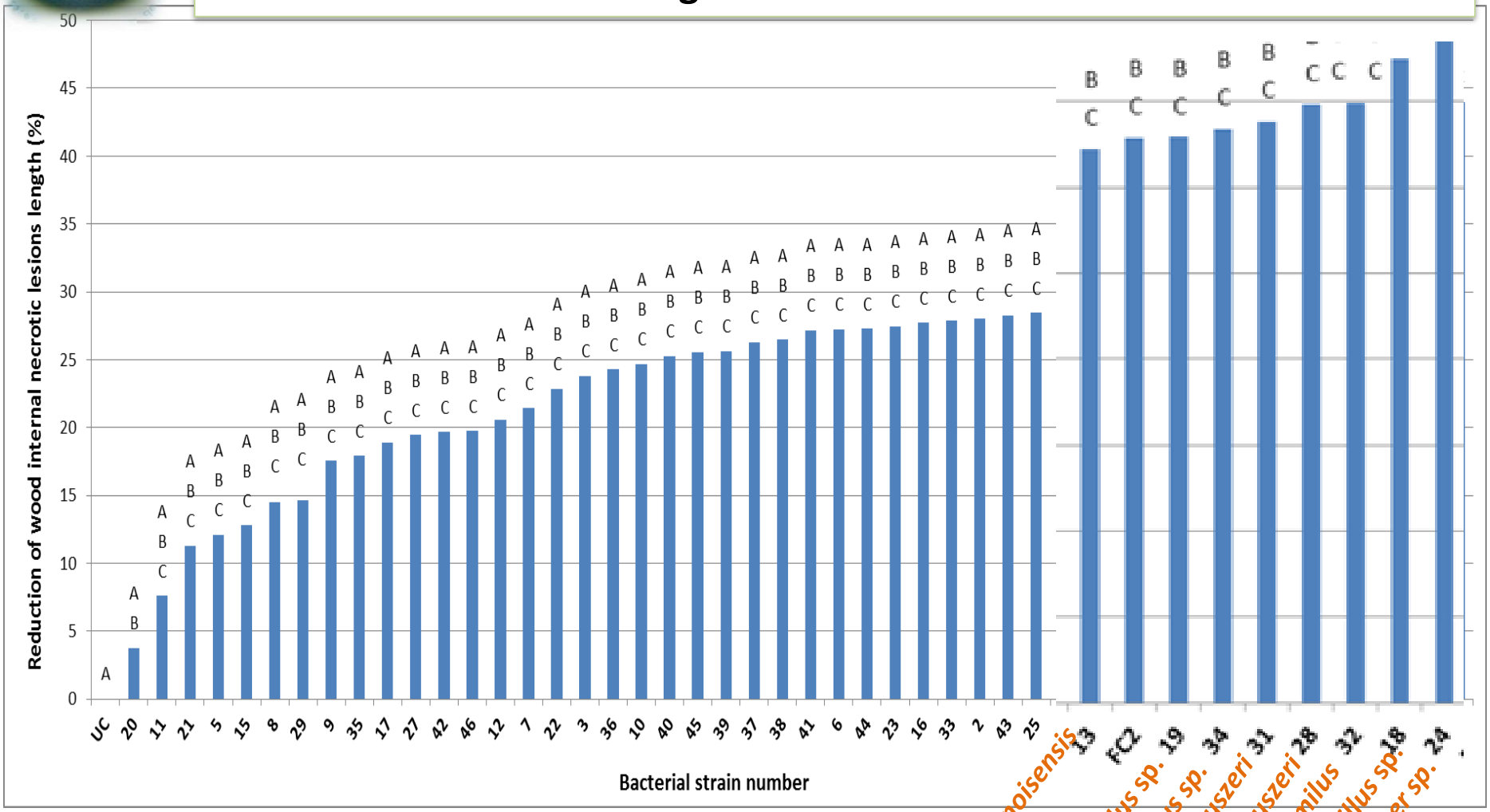
Measuring of necrotic lesions

Résultats

P. chlamydospora



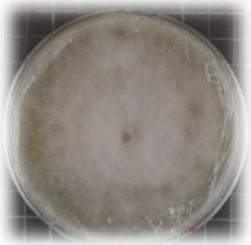
8 bacteria strains: significant reduction of necrosis length in stem cuttings between 32 and 39%



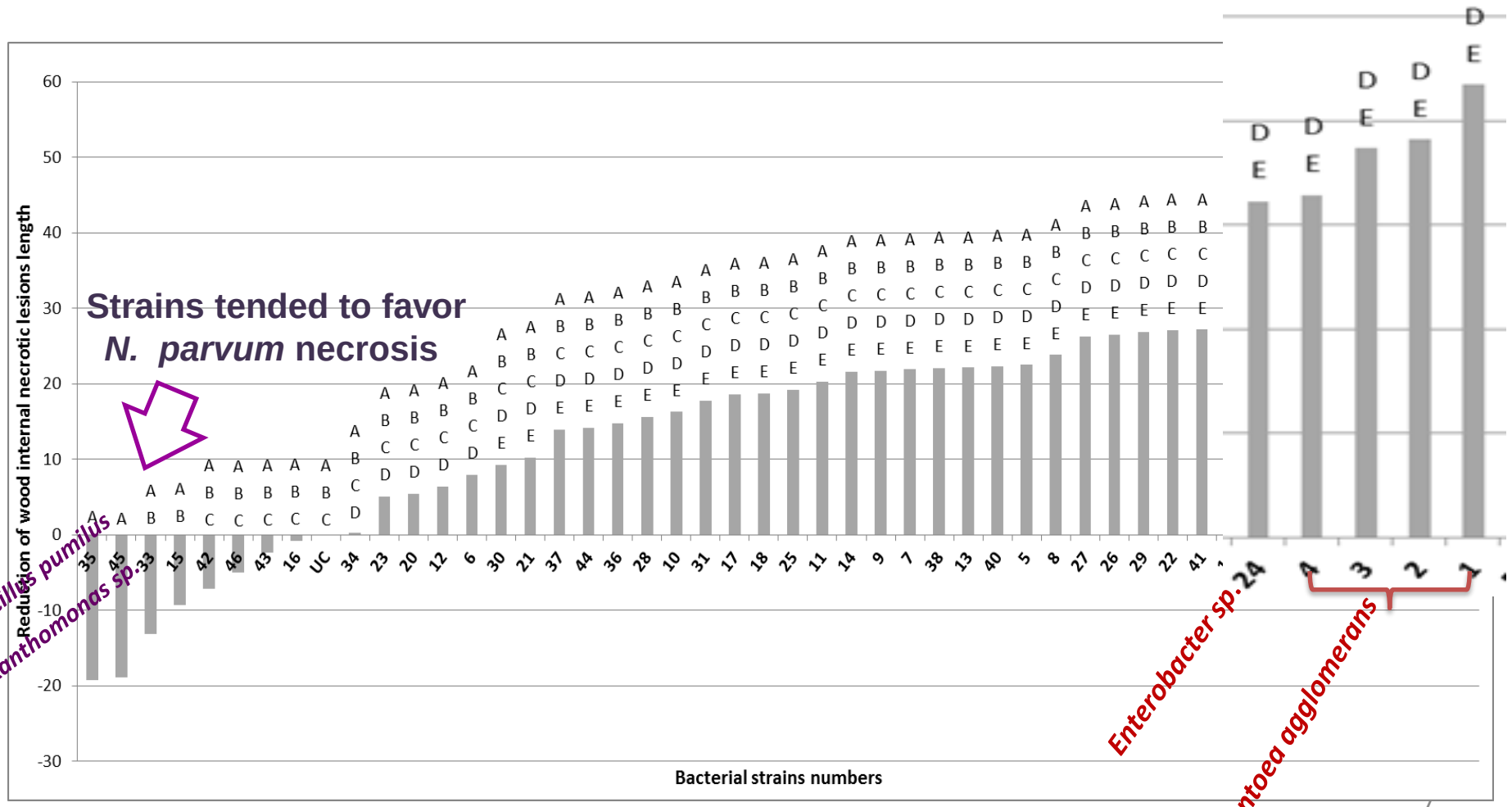
Haidar et al., 2016; *Microbiological Research*

Résults

N. parvum



5 bacteria strains: significant reduction of necrosis length in stem cuttings between 33 and 44%



Haidar et al., 2016; Biological control

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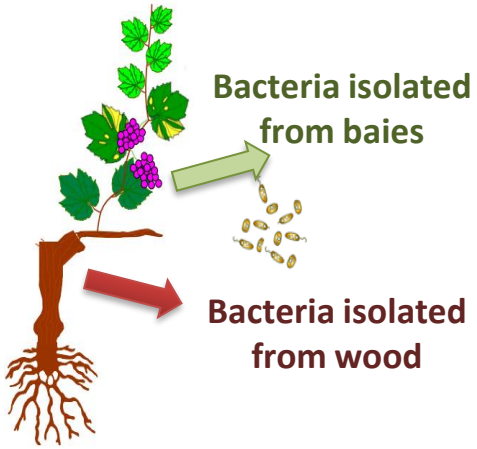
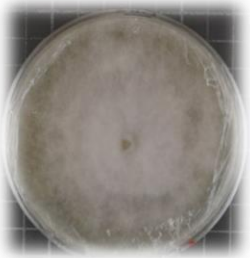
Screening of efficient bacteria against Pch and Np





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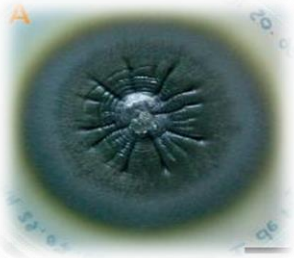

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2nd bioassay

9 strains x 3 methods of bacterial application

1st *in planta* bioassay

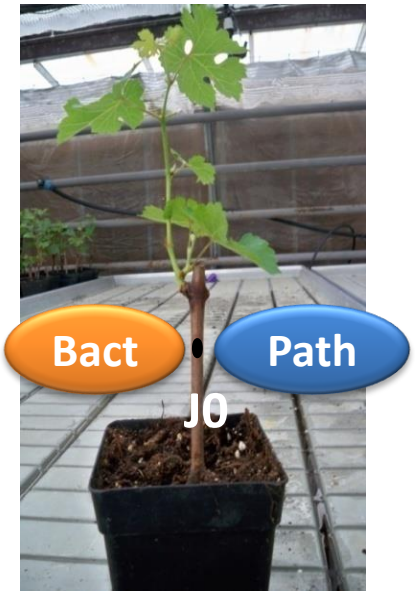
9 strains

N. parvum

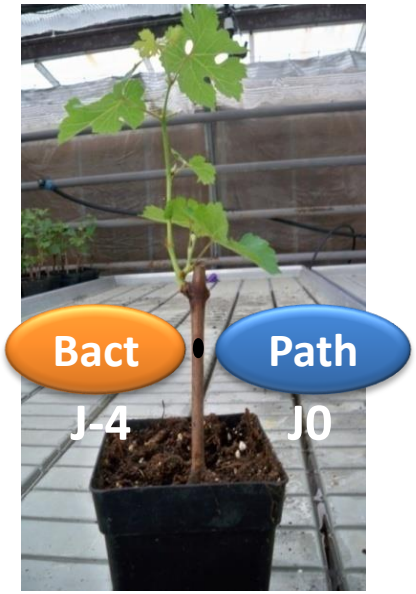
***Brevibacillus reuszeri* (S27)**
***Bacillus firmus* (S41)**
***Pantoea agglomerans* (S1, S3)**

P. chlamydospora

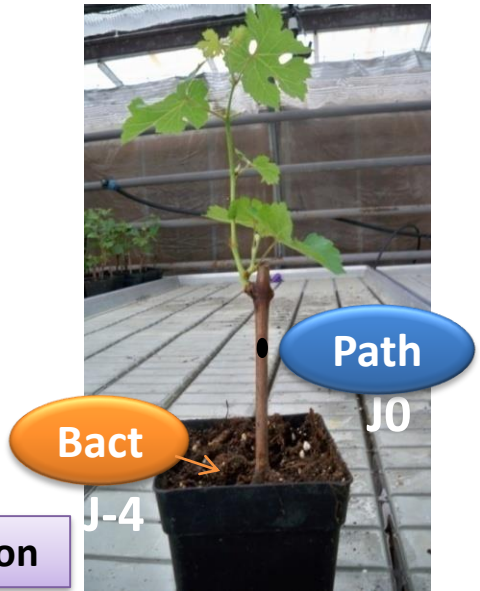
***Enterobacter* sp. (S24)**
***Paenibacillus* sp. (S18, S19)**
***Bacillus pumilus* (S32)**
***Brevibacillus reuszeri* (S28)**



Co-inoculation



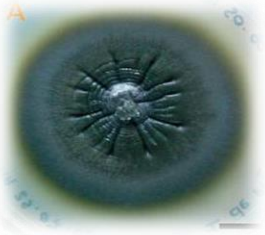
Preventive inoculation in the hole



Preventive soil inoculation

2nd bioassay

Résults: *P. chlamydospora, N. parvum*



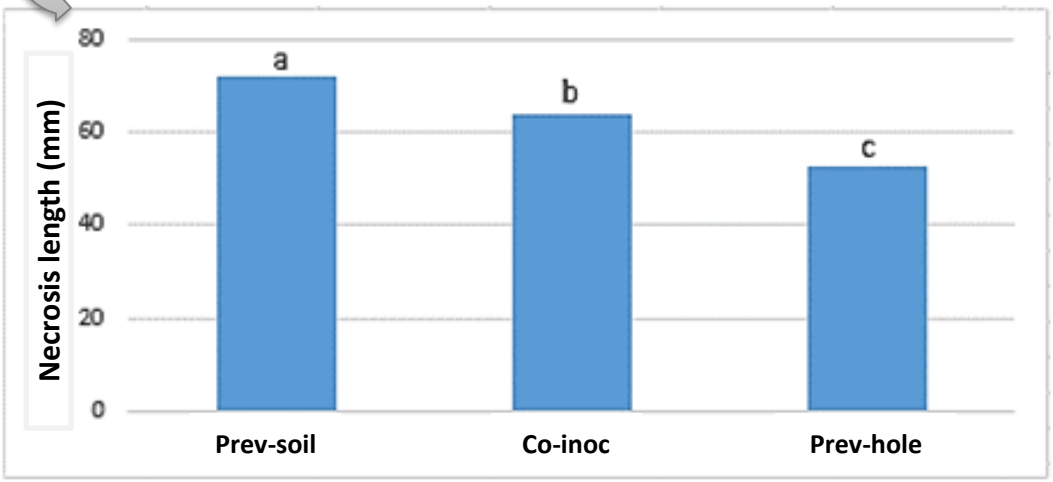
P. chlamydospora

Haidar et al., 2016; *Microbiological Research*

The effect of bacterial strain and the effect of application method was not significant

✓bacterial efficiency was more strain dependent than inoculation method dependent

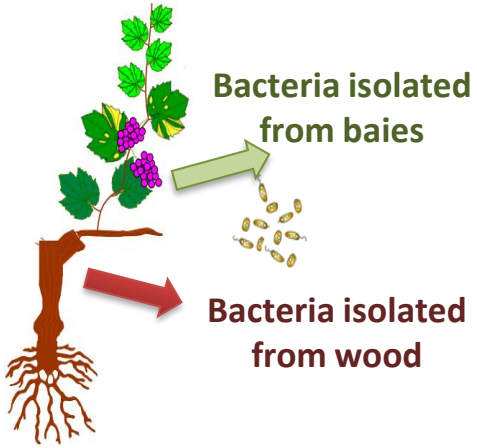
N. parvum

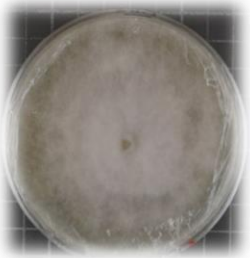


✓ bacterial efficiency dependent on the inoculation method

✓Drenching the plant soil with the same bacterial strains was less efficient than the application in the hole

Screening of efficient bacteria against Pch and Np





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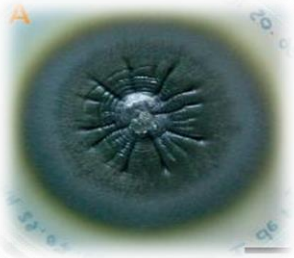

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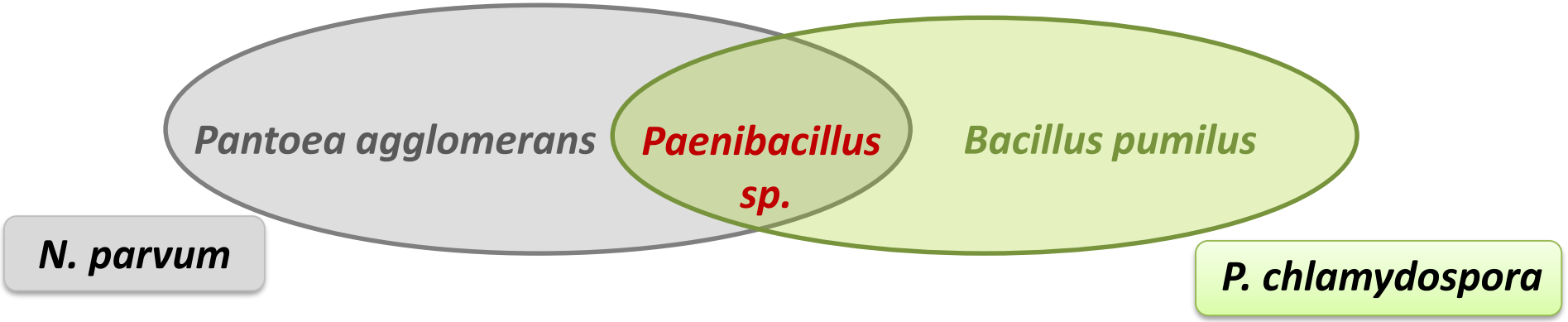
Bacterial strains of interest and modes of action

3 selected strains:

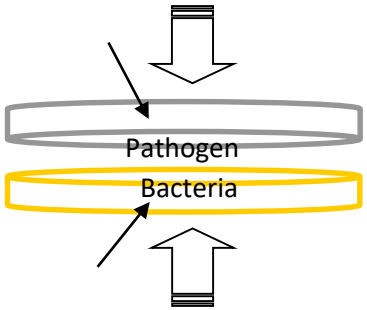


Modes of action of selected bacteria

Induction of grapevine defense

qPCR

Production of volatile compounds

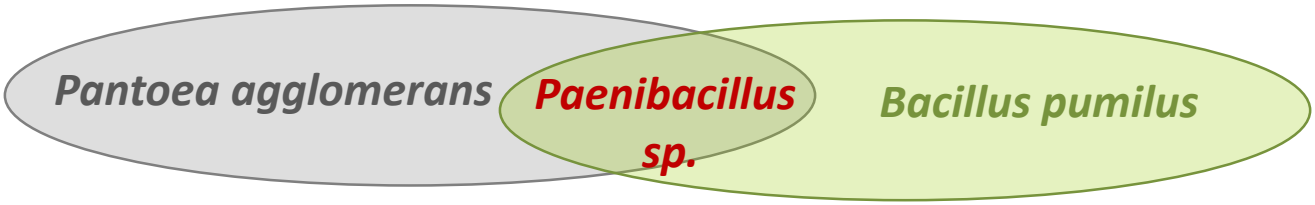


Production of diffusible compounds

confrontation

Bacterial strains of interest and modes of action

3 selected strains:



N. parvum

P. chlamydospora

Modes of action of selected bacteria

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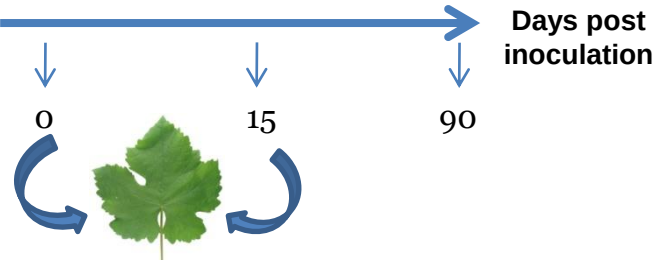


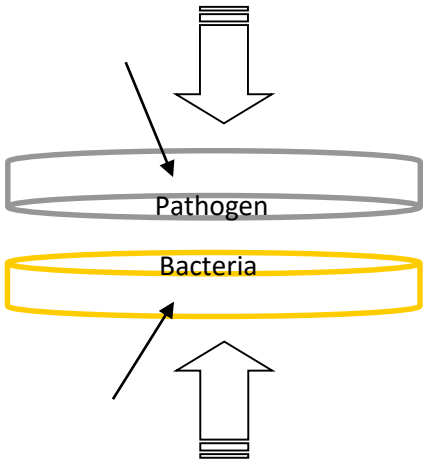
Bact/Path Prev hole

Bact

Path

Bact/Path Co-inoc

Production of volatile compounds



Production of diffusible compounds

confrontation

Results

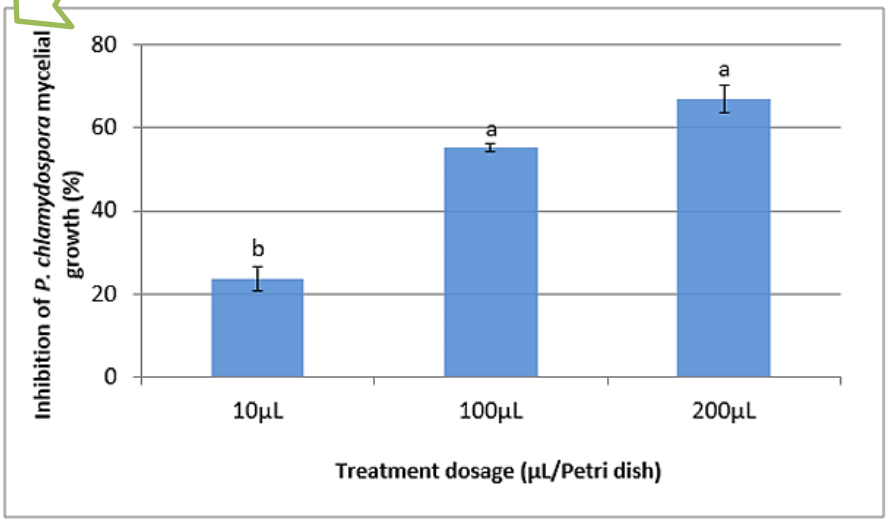
Production of volatile compounds

Bacterial strain	Volatile compound	Retention time (minute)	Molecular weight (g/mol)
S19 (*Paenibacillus* sp.)	Compound of pyrazine type	12.8	–
	2,6-Bis (2-methylpropyl) pyrazine	12.4	192.3
	1-Octen-3-ol	6.9	128.22
S32 (*Bacillus* [illegible]*illus*)	2,5-dimethyl Pyrazine	5.4	108.14
	3-octanone	6.6	128.21
	trimethyl-pyrazine	6.8	122.17
	2-ethyl-3,5-dimethyl pyrazine	8.1	136.19
S1 (*P. agglomerans*)	Phényl éthyl alcohol	8.6	22.16

Gas Chromatography-Mass Spectrometry

1-Octen-3-ol:

Inhibition of Pch >96%



2,5-dimethyl pyrazine

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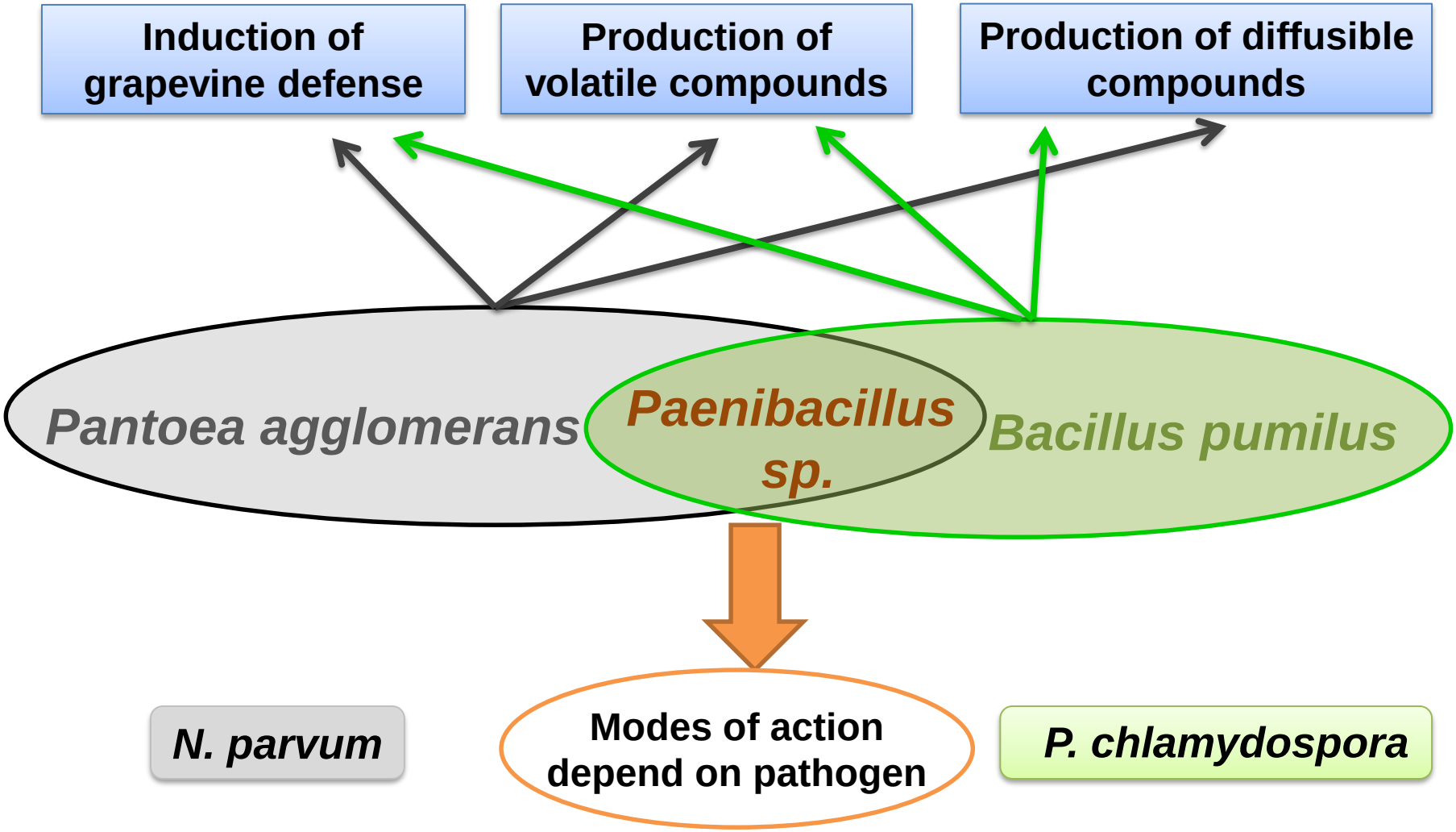
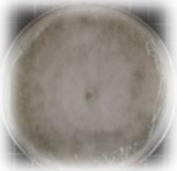
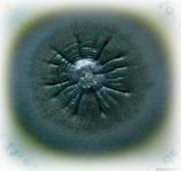


Conclusions





	N. parvum	*P. chlamydospora*
1	➢ The most efficient strains: Enterobacteriales ➢ Some bacterial strains increase *N. parvum* necrosis	➢ The most efficient strains: Bacillales No
2	➢ Bacterial efficiency dependent on the inoculation method	No
3	No ➢ *Paenibacillus* sp. inhibits Np by the induction of grapevine defense	➢ *Paenibacillus* sp. inhibits Pch by production of volatile compounds No

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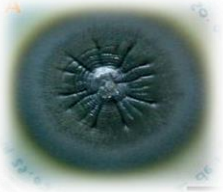

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Jessica Vallence

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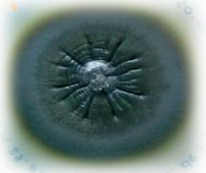

Thanks for your attention

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PR proteins	***VvPR1***	PR protein class1
	VvPR10	PRprotein class10
	VvCHIT3	ChitinaseclassIII
	VvGLU	ß-1,3glucanase
cell wall reinforcement	***VvCALS***	Callosesynthase
Redox status	***VvGST***	GlutathioneS-transferase
Indole and phenylpropanoid pathways	***VvANTS***	Antranilatesynthase
	VvSTS	Stilbenesynthase
	VvCHS	Chalconesynthase
	VvPAL	Phenylalanineammonialyase