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

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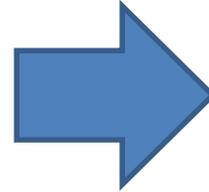
Screening and modes of action of
antagonistic bacteria to control two fungal
pathogens, *Phaeomoniella chlamydospora*
and *Neofusicoccum parvum*, involved in
grapevine trunk diseases

Haidar Rana

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

2001

sodium arsenite

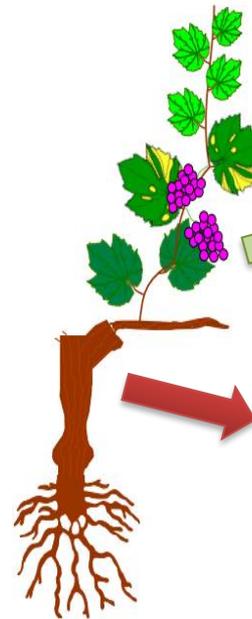


Control with biological control agents (BCAs)

No efficient strategies to control GTDs

**Bacteria
as BCAs against GTDs**

46 bacterial
strains



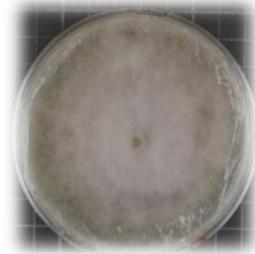
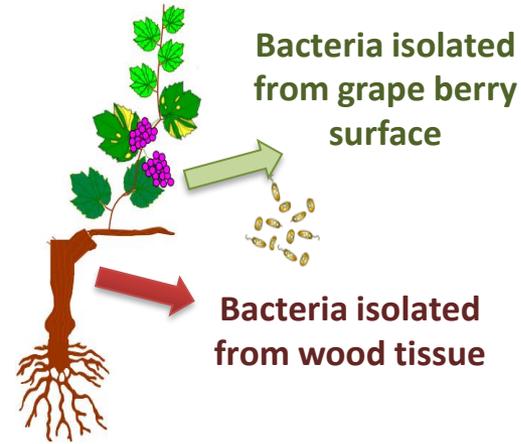
Bacteria isolated from
grape berry surface

Martins et al., 2012

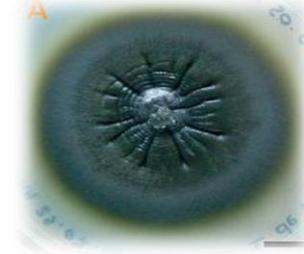
Bacteria isolated from
wood tissue

Bruez et al., 2015





N. parvum (Np)



P. chlamydospora (pch)

1

Evaluation, *in planta*, of the antagonistic activity of **46** bacterial strains against *P. chlamydospora* and *N. parvum*



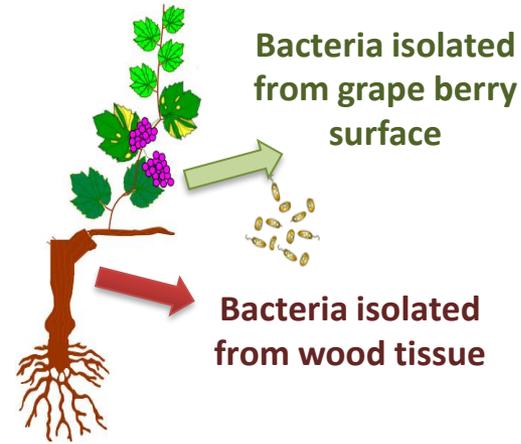
2

Evaluation of the effect of application method on biocontrol efficacy of **9** selected strains

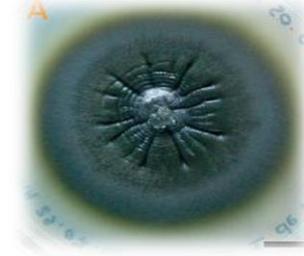


3

Identification of the modes of action for **3** selected strains



N. parvum (Np)



P. chlamydospora (pch)

1

Evaluation, *in planta*, of the antagonistic activity of 46 bacterial strains against *P. chlamydospora* and *N. parvum*



2

Evaluation of the effect of application method on biocontrol efficacy of 9 selected strains



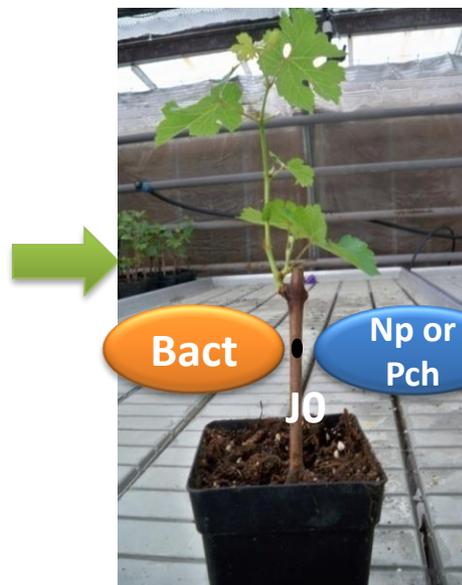
3

Identification of the modes of action for 3 selected strains

Experimental design :



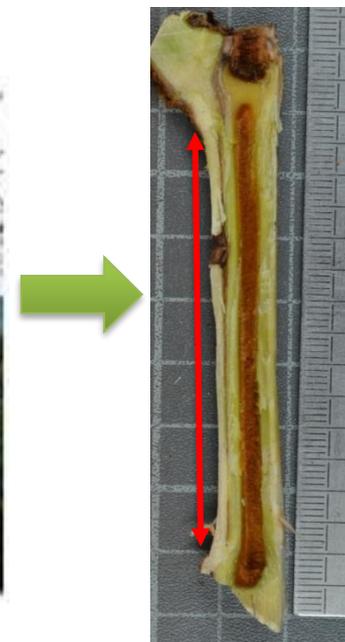
Cabernet Sauvignon cuttings



Bacteria/pathogen Co-inoculation

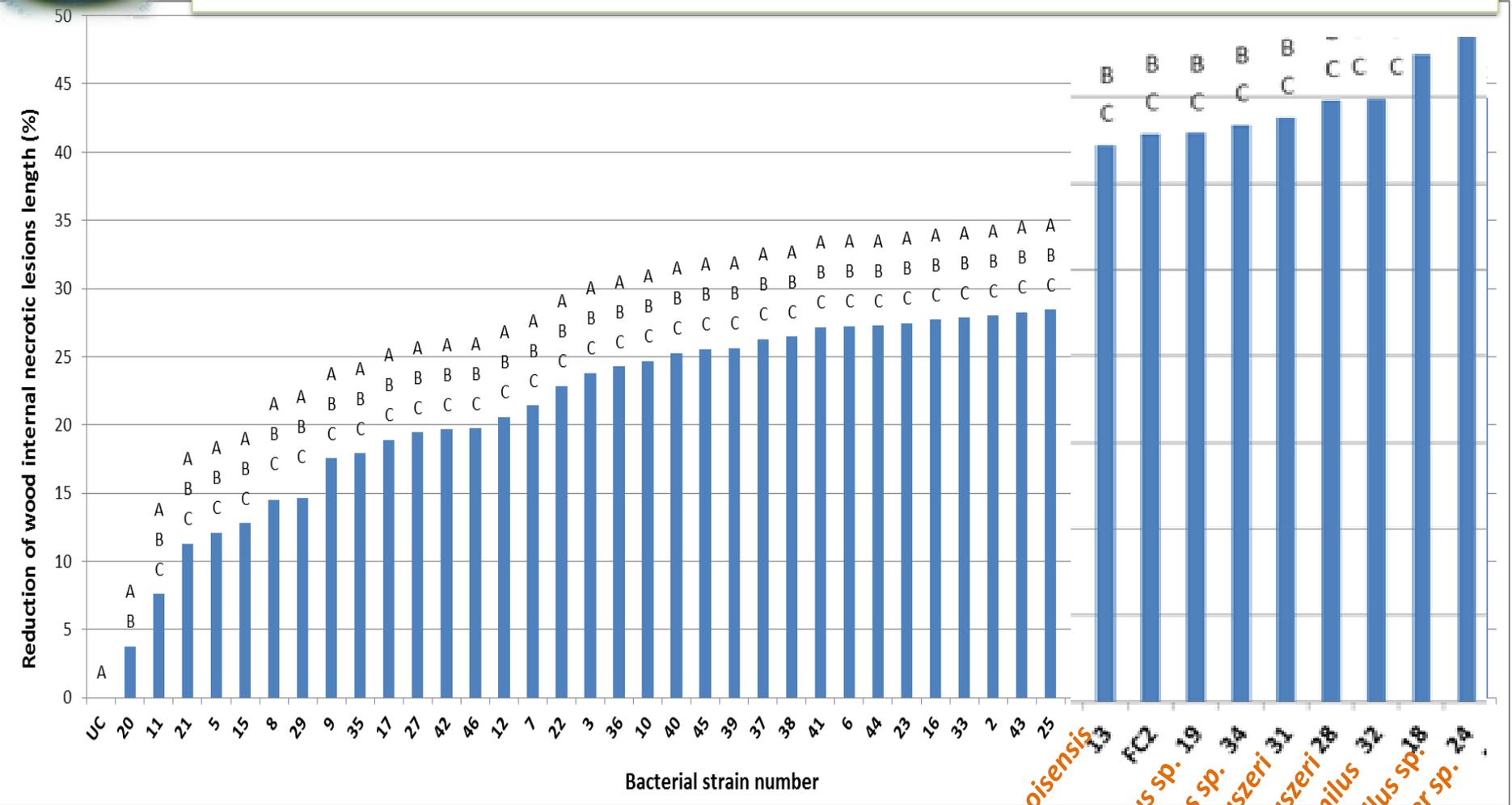


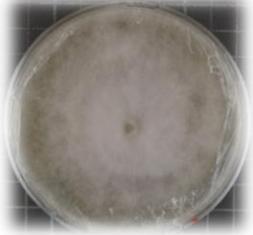
Incubation in open greenhouse



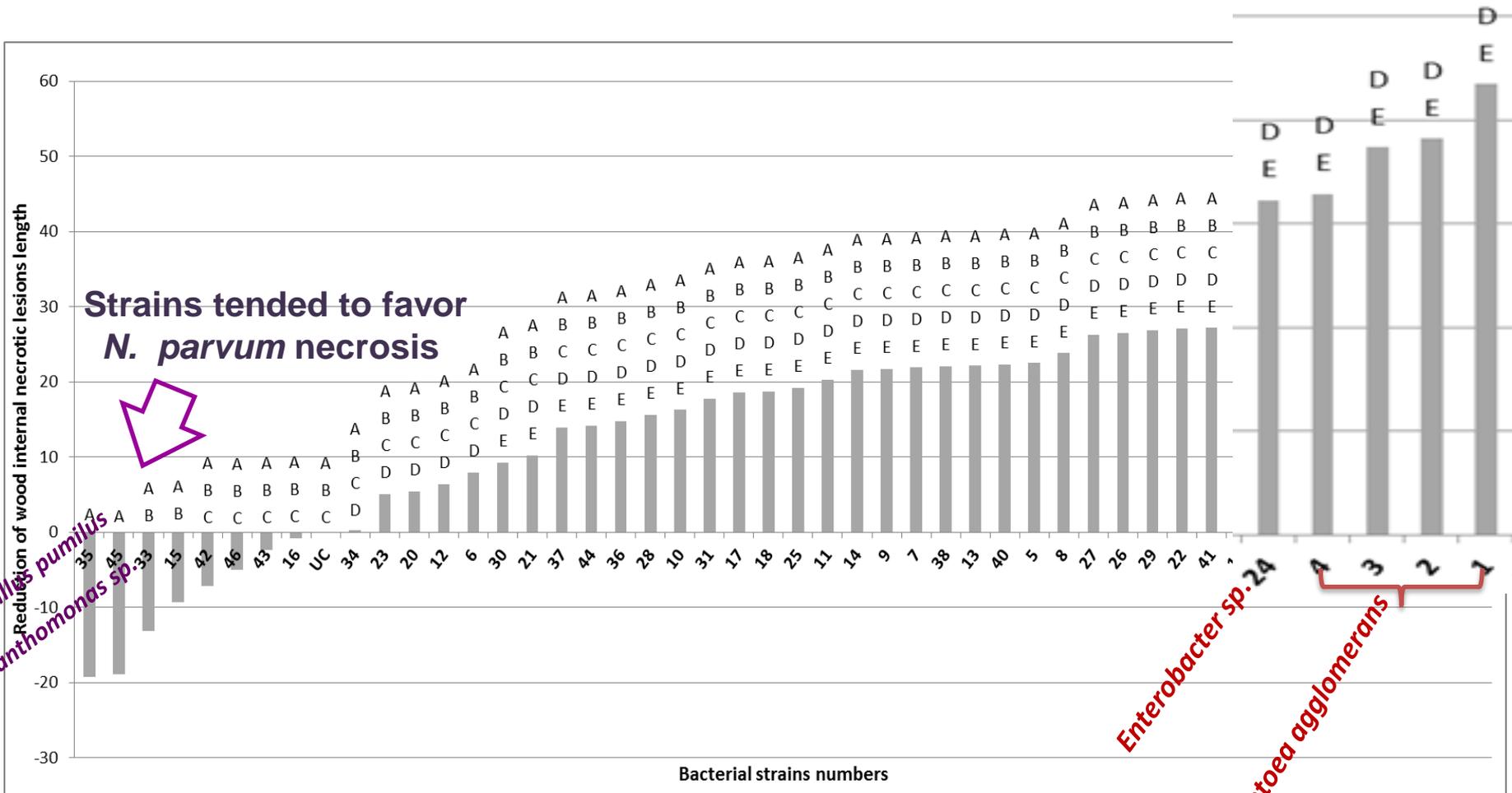
Measuring of necrotic lesions

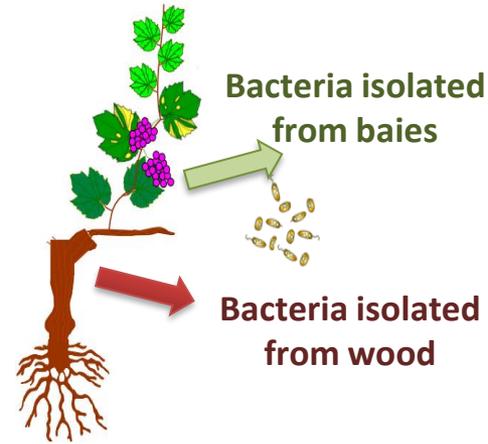
8 bacteria strains: significant reduction of necrosis length in stem cuttings between 32 and 39%



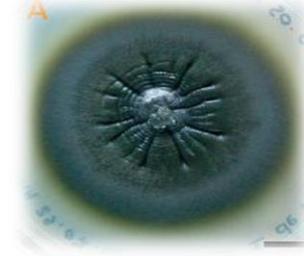


5 bacteria strains: significant reduction of necrosis length in stem cuttings between 33 and 44%





N. parvum (Np)



P. chlamydospora (pch)

1

Evaluation, *in planta*, of the antagonistic activity of 46 bacterial strains against *P. chlamydospora* and *N. parvum*

2

Evaluation of the effect of application method on biocontrol efficacy of 9 selected strains

3

Identification of the modes of action for 3 selected strains

1st *in planta* bioassay

9 strains

N. parvum

Brevibacillus reuszeri (S27)

Bacillus firmus (S41)

Pantoea agglomerans (S1, S3)

P. chlamydospora

Enterobacter sp. (S24)

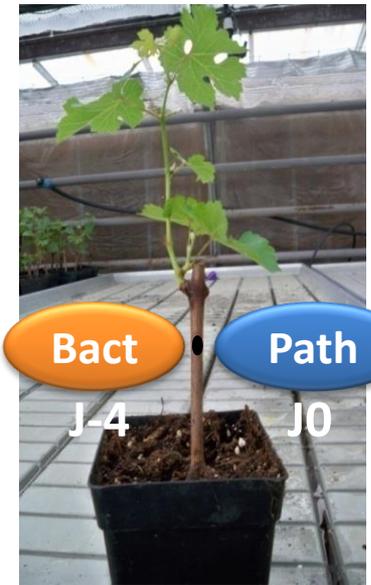
Paenibacillus sp. (S18, S19)

Bacillus pumilus (S32)

Brevibacillus reuszeri (S28)



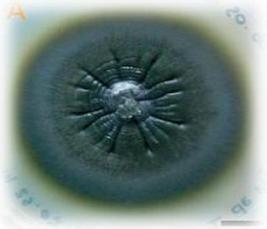
Co-inoculation



Preventive inoculation in the hole



Preventive soil inoculation



P. chlamydospora

Haidar et al., 2016; *Microbiological Research*

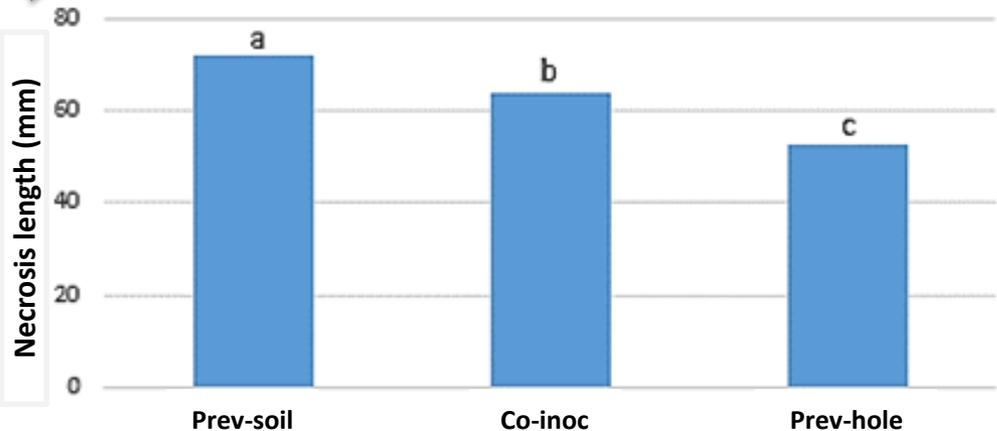
The effect of bacterial strain and the effect of application method was not significant



✓ bacterial efficiency was more strain dependent than inoculation method dependent

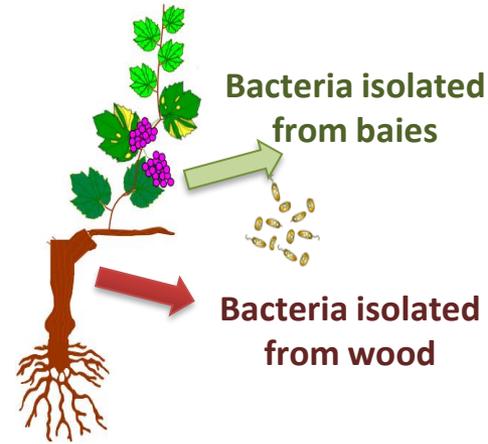


N. parvum

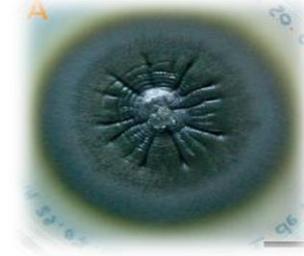


✓ bacterial efficiency dependent on the inoculation method

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



N. parvum (Np)



P. chlamydospora (pch)

1

Evaluation, *in planta*, of the antagonistic activity of 46 bacterial strains against *P. chlamydospora* and *N. parvum*

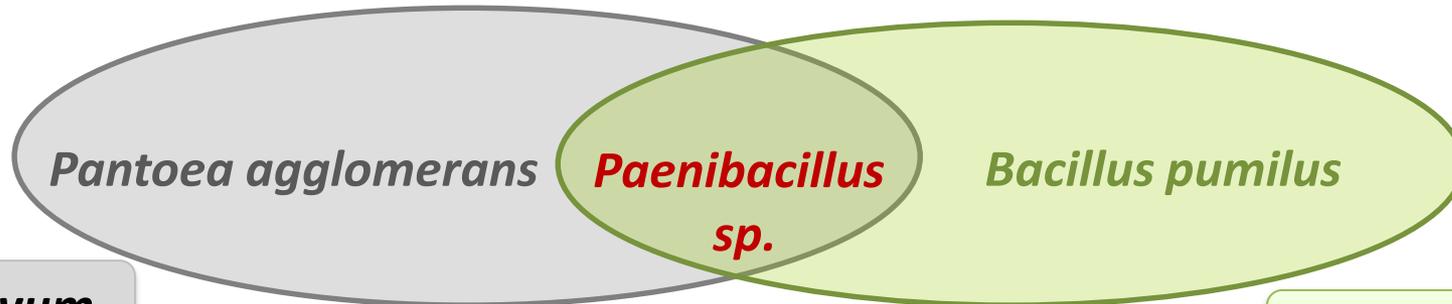
2

Evaluation of the effect of application method on biocontrol efficacy of 9 selected strains

3

Identification of the modes of action for 3 selected strains

3 selected strains:

*N. parvum**P. chlamydospora*

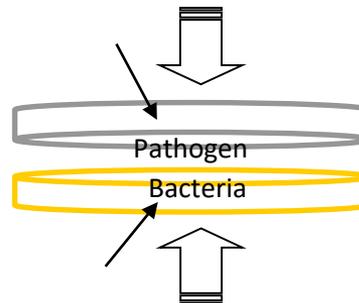
Modes of action of selected bacteria

Induction of grapevine defense



qPCR

Production of volatile compounds

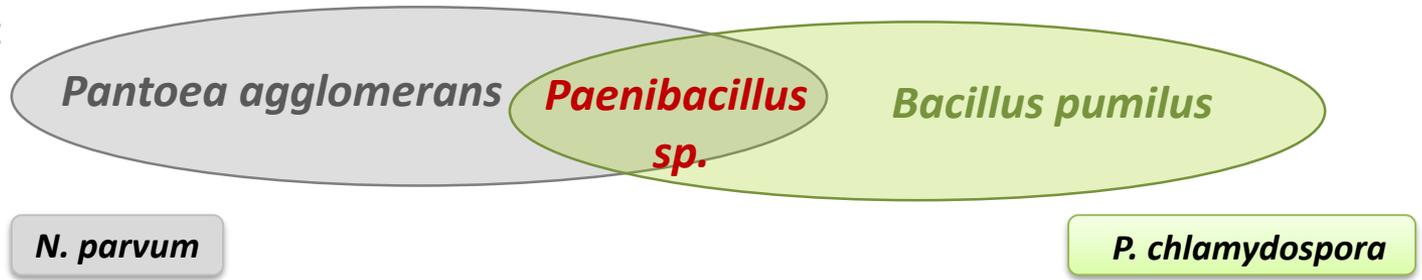


Production of diffusible compounds



confrontation

3 selected strains:

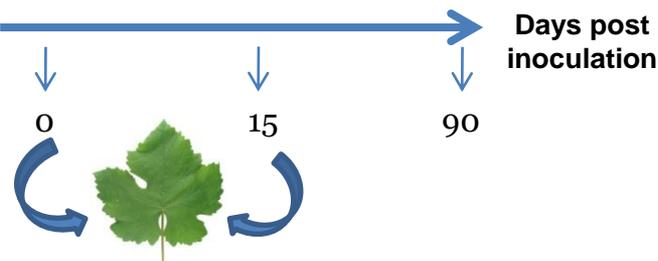


Modes of action of selected bacteria

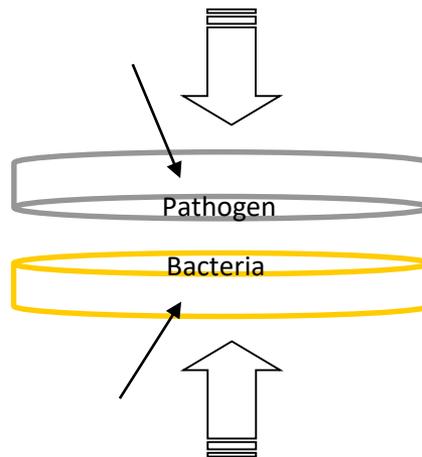
Induction of grapevine defense



qPCR



Production of volatile compounds



Production of diffusible compounds



confrontation

Results

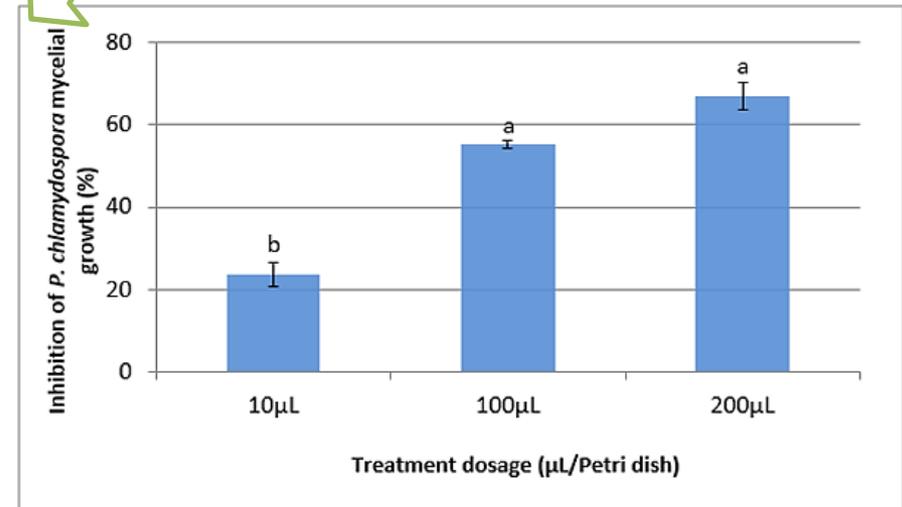
Production of volatile compounds

Bacterial strain	Volatile compound	Retention time (minute)	Molecular weight (g/mol)
S19 (<i>Paenibacillus</i> 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
	2,5-dimethyl Pyrazine	5.4	108.14
S32 (<i>Bacillus pumilus</i>)	3-octanone	6.6	128.21
	trimethyl-pyrazine	6.8	122.17
	2-ethyl-3,5-dimethyl pyrazine	8.1	136.19
	Phényl éthyl alcohol	8.6	22.16

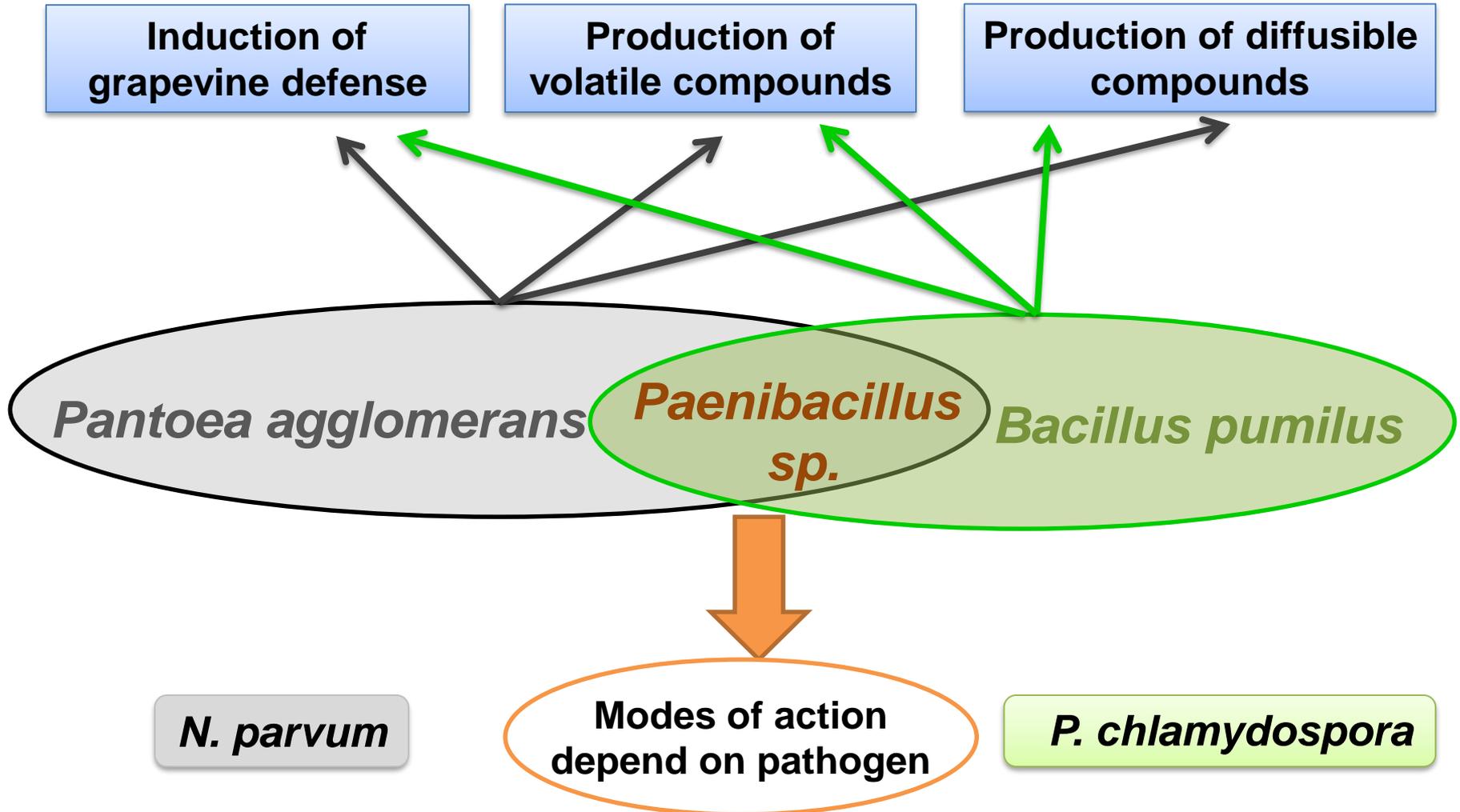


Gas Chromatography-Mass Spectrometry

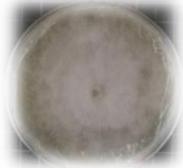
1-Octen-3-ol:
Inhibition of Pch
>96%



2,5-dimethyl pyrazine

3 selected strains:

Conclusions



N. parvum



P. chlamydospora

1

➤ The most efficient strains:
Enterobacterales

➤ 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



**Marc Fermaud, Alain Deschamps
(Supervisors)
Patrice Rey
Jean Roudet
Emilie Bruez
Jessica Vallence**



Casdar V1302





Thanks for your attention



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

