Disease suppression in cropping systems

2-9-2015

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Outline presentation:

- Disease suppressive soils
- Research: can we stimulate disease suppressiveness?
- *Phytophthora cactorum* in strawberry
  - Disease suppressive substrate
  - Plant resilience
  - Mycorrhiza
- Application potential in practice?

Disease suppressive soil:

Suppressive soil =

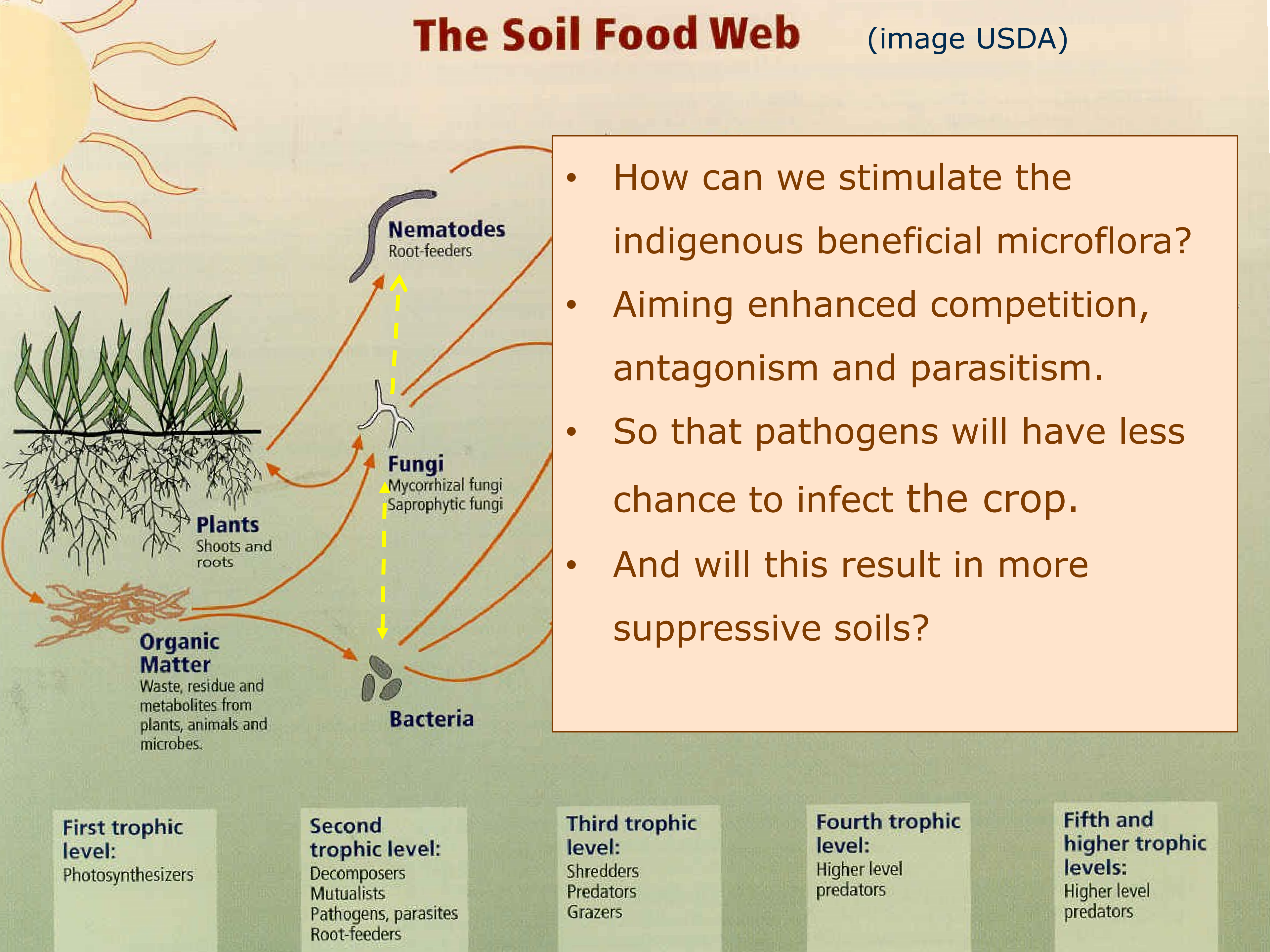
Soil with limited or no damage in a sensitive crop even when the pathogen is present

Abiotic factors: pH, texture, …

Biotic factors: suppression is lost after sterilization

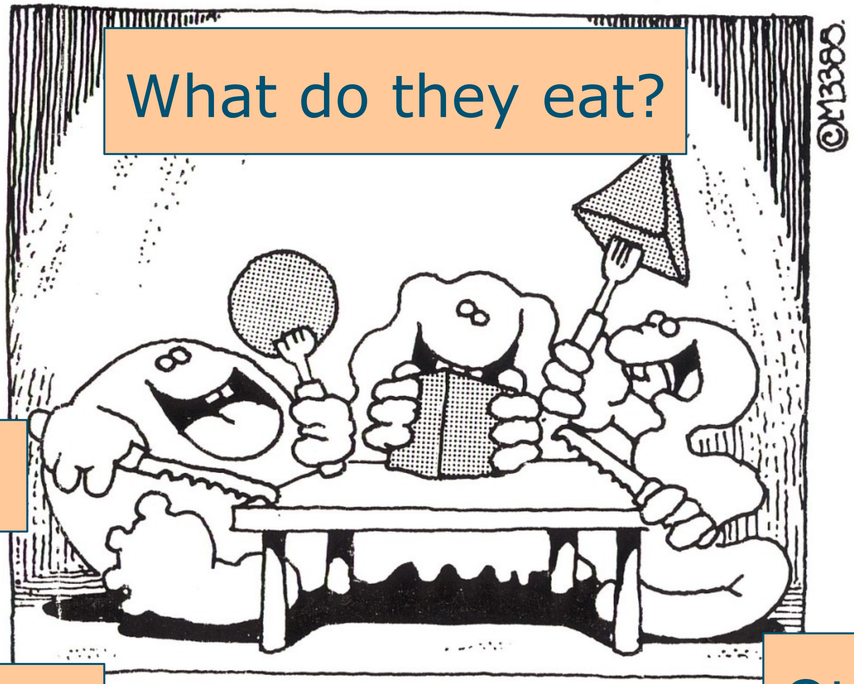
Mode of action?
Which organisms ?

The Soil Food Web (image USDA)



- How can we stimulate the indigenous beneficial microflora?
- Aiming enhanced competition, antagonism and parasitism.
- So that pathogens will have less chance to infect the crop.
- And will this result in more suppressive soils?

Soil micro-organisms



What do they eat?

Root cells

Exudates

Organic matter

Other MO

- Can we stimulate the beneficial part of the population?

Effect of organic matter

Disease suppressiveness with fresh and stable organic matter (OM):

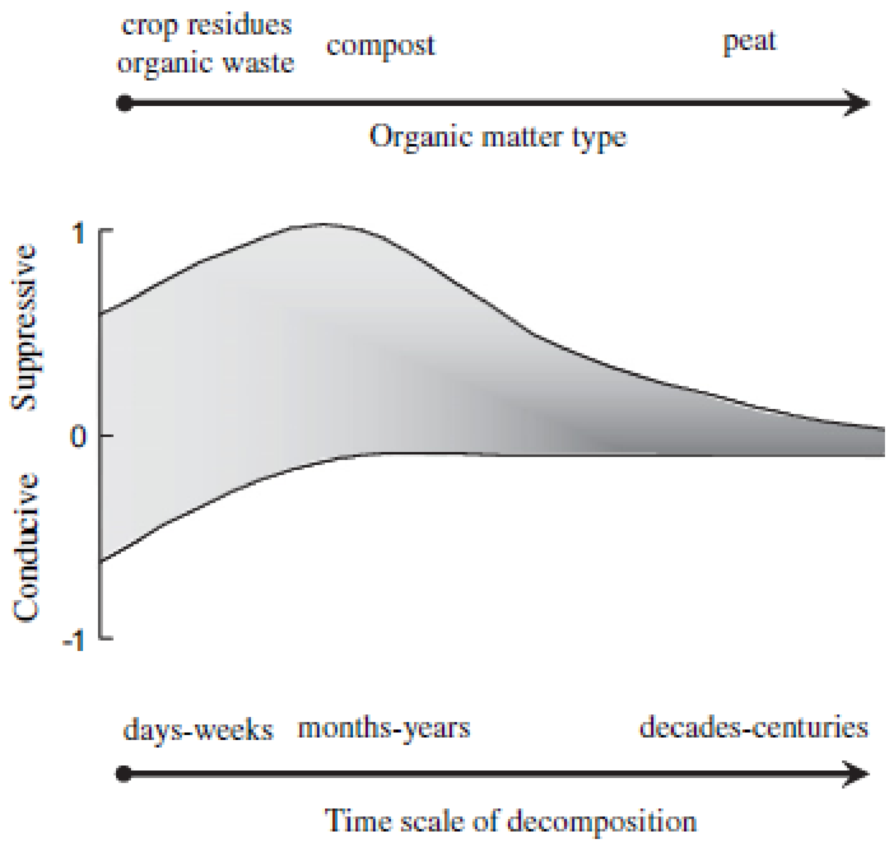


Fig. 4. Schematic representation of disease suppression dynamics during organic matter decomposition.

Meta-analysis by Bonanomi et al. 2010

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Effect of compost & biochar

Greenhouse tomato assays (2012-2015)

Effect of compost and biochar on:

- Germination
- Plant growth
- N P K uptake
- Control of Pythium

All treatments were with and without *Pythium aphanidermatum*

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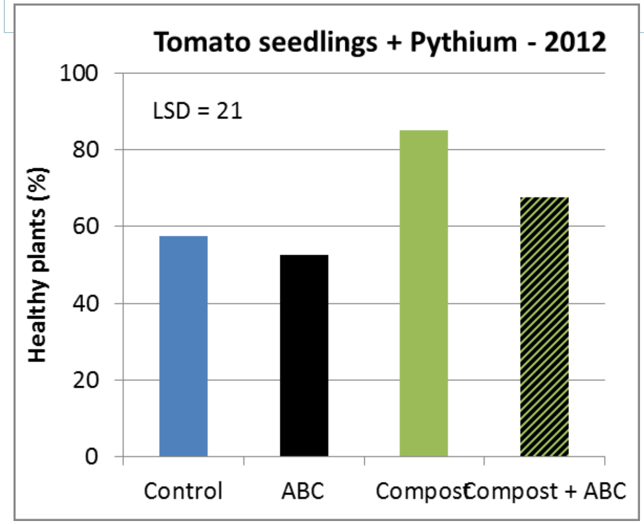
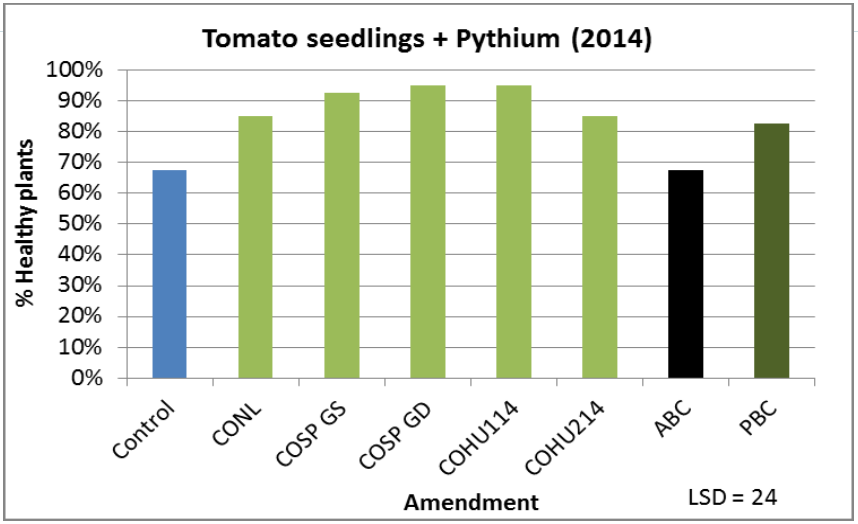
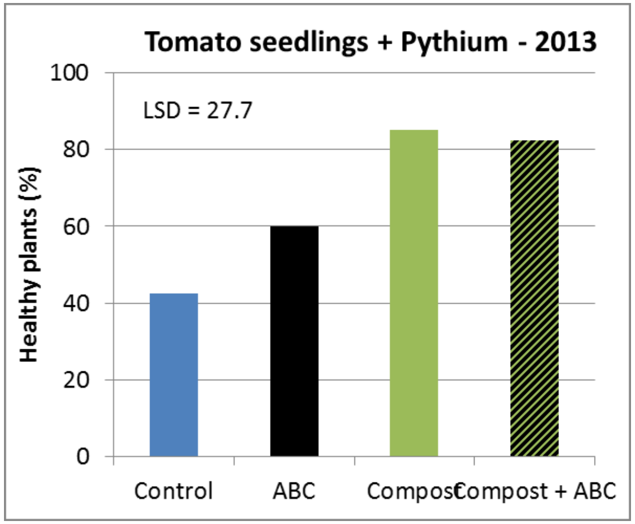
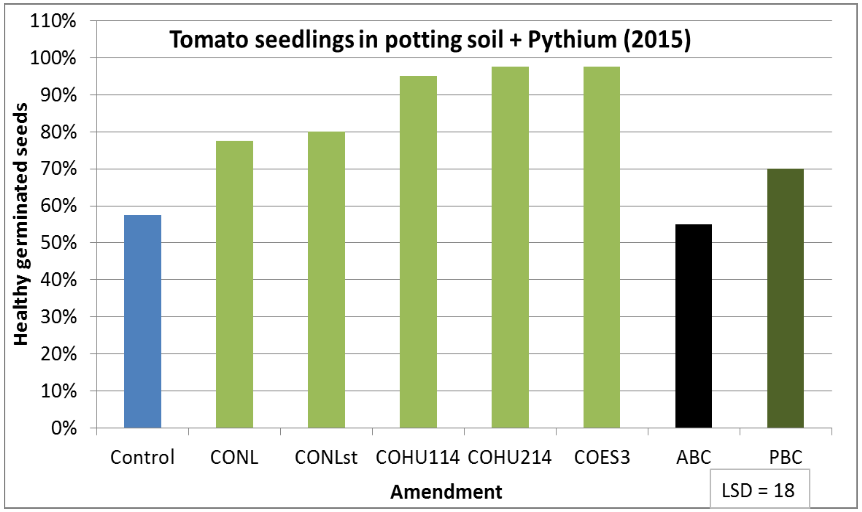
Pythium control by compost: 2012-2014









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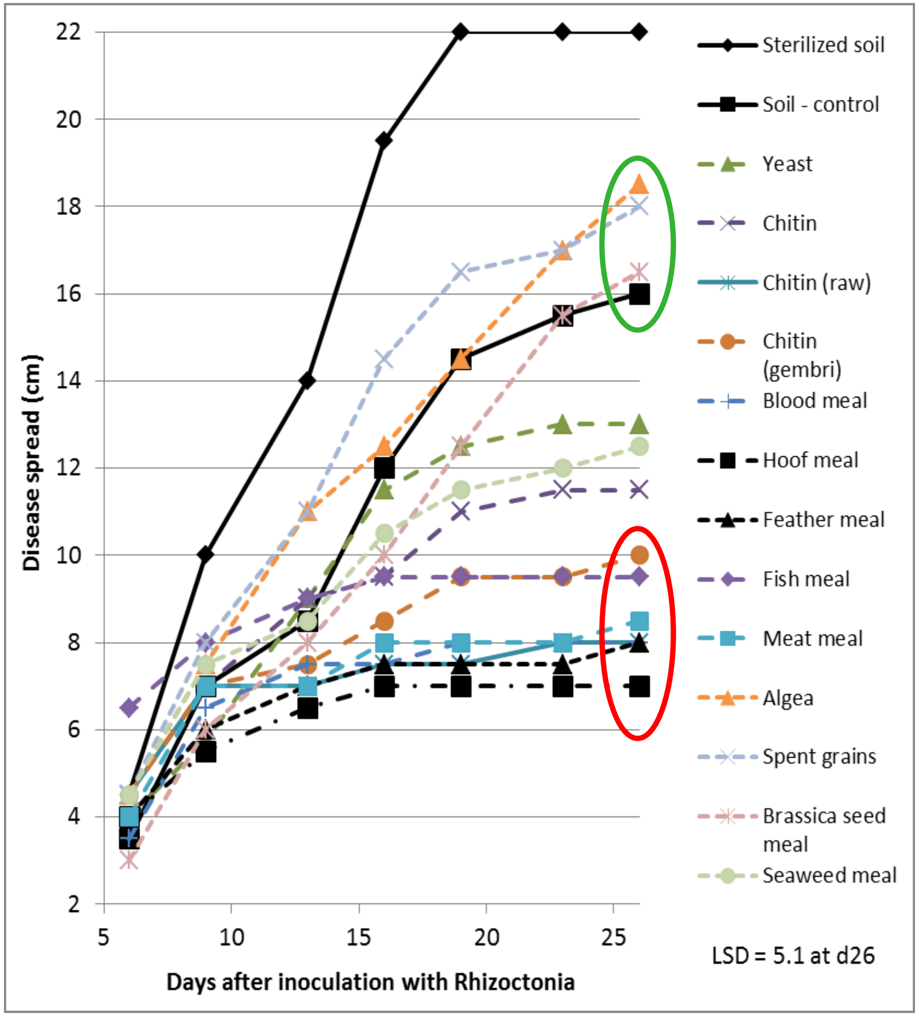
Enhancing *Rhizoctonia* disease suppression

- Chitin, feather & hoof meal etc. enhance *Rhizoctonia* suppression
- No effect with plant derived materials
- Effective in bioassays with sugar beet, cauliflower, lettuce, ..



Postma & Schilder, 2015

Stable organic matter - field experiment:

- Experiment at PPO-Lisse: dune sand: 0.7% OM
- Stable OM (peat) was added up to 1.4 and 3 %
- Sterilized & non-sterilized soil was tested for disease suppression in bioassays to test the role of soil biota

	Disease suppression	
Pathogen	**Organic matter**	**Soil biota**
Meloïdogyne	++	++
Pratylenchus	+	+
Pythium	+	++
Rhizoctonia	-	+

Dutch research program on soil quality

BETER
BODEMBEHEER

Beter Bodembeheer bundelt alle kennis uit het onderzoek over duurzaam bodembeheer in de landbouw op één plek

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Thema's


Bodemvruchtbaarheid


Bodemweerbaarheid


Integraal bodembeheer


Structuur en bewerking

Phytophthora cactorum in strawberry

Leather rot on fruit

Leather rot of strawberry caused by P. *cactorum*

(Photo courtesy of F.J. Louws, NC State University)

Crown rot

Wilt of plants

- An increasing problem & extensive fungicide use
- Dominant cultivars are (highly) susceptible

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Compost for suppression in substrate against *Phytophthora* in strawberry?

- We never had a positive effect!

Different results depending on plant-pathogen system

PPO - 2012

Standard area under the disease progress curve (stAUDPC) based on disease severity caused by *P. cactorum* in strawberry transplants

Treatment	***P. cactorum* – mixed in substrate**	***P. cactorum* - bottom of pot**
Control	32.6 ab [1]	13.0 b
Paraat	14.7 a	3.4 a
FD Compost	49.8 bcd	13.1 b
Chitin	46.1 bcd	14.4 b
*Trichoderma*T22	57.2 d	13.5 b
Acremonium	45.0 bcd	10.3 b
Pseudomonas	54.0 cd	26.7 c
Salicylic acid	36.0 bc	3.6 a
Bacterial antagonist	44.0	3.4

Elsanta

[1]: Values within each column followed by the same letter are not significantly different (P=0.05)

PPO - 2013

Standard area under the disease progress curve (StAUDPC) based on disease severity caused by *P. cactorum* in strawberry transplants

Treatment	*P. cactorum* – mixed in substrate	*P. cactorum* – bottom of pot
Control	35.8 c [1]	20.7 d
Paraat	18.0 ab	14.3 bcd
FD Compost	29.2 bc	18.6 cd
Trichoderma T22	38.0 c	18.8 cd
Acremonium	23.8 abc	11.0 abc
Salicylic acid	38.1 c	2.5 a
Lepidium	34.6 bc	4.4 a
Bacterial antagonist	10.6 a	8.7 ab

Sonata

[1]: Values within each column followed by the same letter are not significantly different (P=0.05)

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PPO - 2014

StAUDPC based on disease severity caused by *P. cactorum* in strawberry transplants

	Unrooted plants		A+ rooted plants	
Treatment	***P. cactorum* – mixed**	***P. cactorum* – bottom**	***P. cactorum* – mixed**	***P. cactorum* – bottom**
Control	40.0 c	5.7 ab	1.6 bcd	0.0
Paraat	0.0 a	0.0 a	0.3 ab	0.0
Acremonium	31.5 c	5.2 ab	0.9 abc	0.0
Salicylic acid	11.3 b	4.9 ab	1.9 cd	0.3
Lepidium	36.9 c*	16.7 c*	0 a	0.5
Bacterial antagonist	26.3 c	6.4 bc	2.7 d	0.2

[1]: Values within each column followed by the same letter are not significantly different (P=0.05)

*: too high density of *Lepidium*

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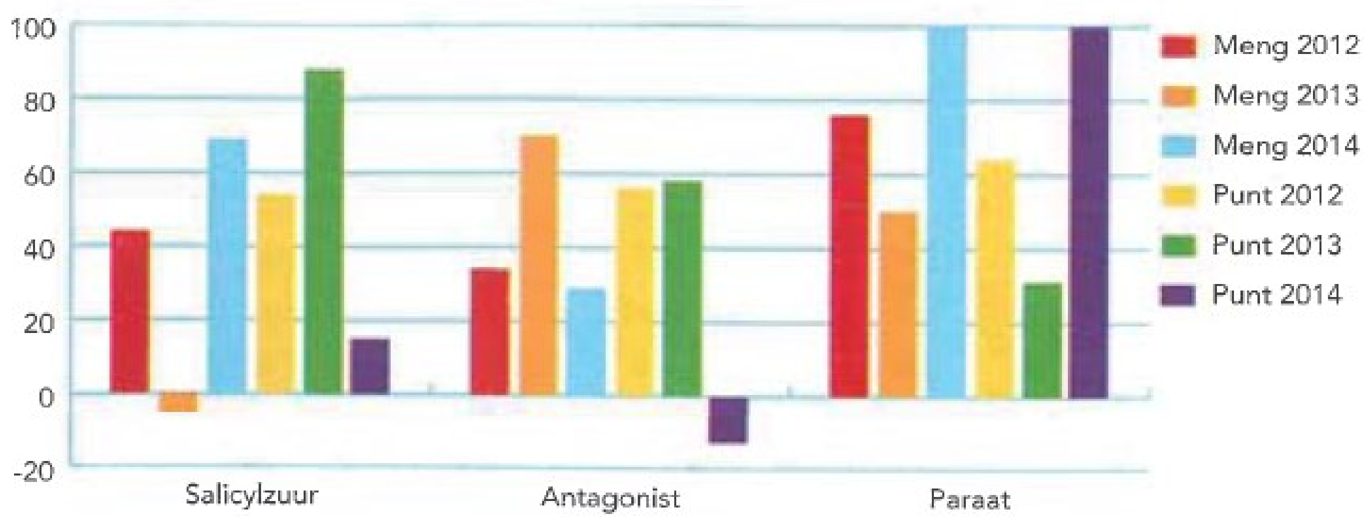
Sonata

Most promising control methods:



De mate waarin de verschillende behandelingen de uitval van aardbeistek tegengingen. Het substraat was geïnoculeerd door Phytophthora erdoorheen te mengen (Meng) of onder in de tray aan te brengen (Punt). Bij 100 procent werd volledige bescherming verkregen; negatieve getallen geven aan dat de behandeling de uitval verergerde.

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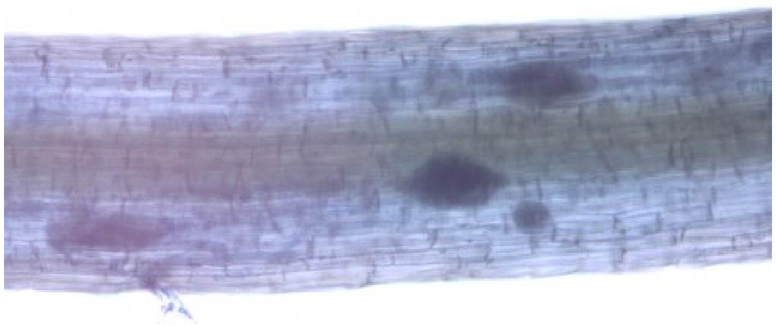
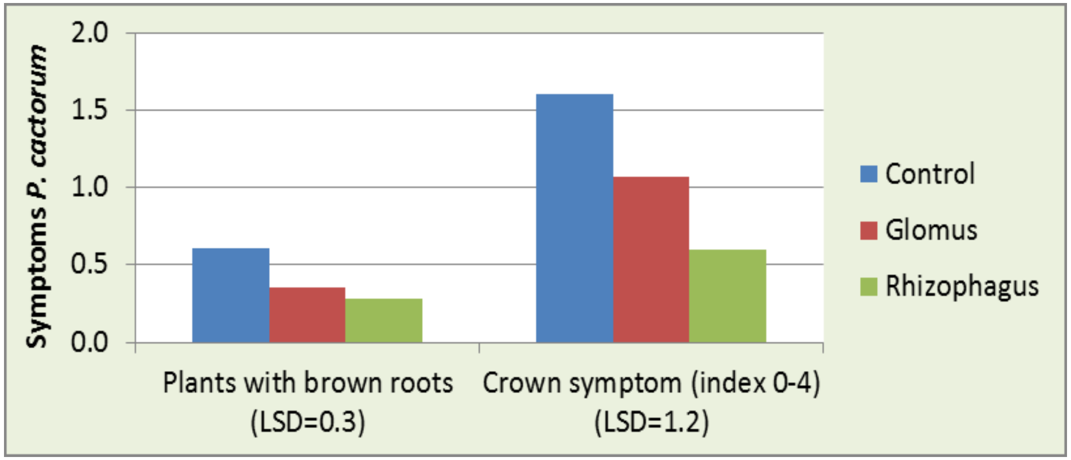
Groente & Fruit (2014) 52:38-39

And: Mycorrhiza tested in 2014

- Mycorrhiza are known for supporting P-uptake
- Strawberry is a good crop for mycorrhiza
- No mycorrhiza present in peat substrates
- Inoculation with *Rhizophagus irregularis* (LUH Henning)
  - ~50 % reduction of *Phytophthora cactorum*





Complexity

- Many different cropping systems
- Pathogen is difficult to control, even Paraat is not always effective
- *Phytophthora* infection route? Runner, root, crown?

Thank you for your attention

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Ministerie van Economische Zaken

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