

Pluton

**A new naturally occurring Plant Growth
Promoting Rhizobacteria.
Pluton is non pathogenic and occurs
Naturally in the soil**

What is Pluton

- **Pluton is a high quality dry flowable formulation of the spores of a naturally occurring bacteria of the bacillus amyloliquefaciens family.**
- **Pluton is a natural product. It is not a GMO.**

Pluton

**Contains 5×10^{10} spores
Per gram**

What does Pluton do?

**A new naturally occurring Plant Growth
Promoting Rhizobacteria.**

Mode Of Action

- **Pluton contains live spores that germinate in the presence of root exudates.**
- **Metabolites that are produced by Pluton stimulate plant growth , increase yield and induce plant resistance mechanisms.**

Benefits of Pluton

- 1. Improved germination**
- 2. Improved rooting**
- 3. Improved yield**
- 4. Increased vigour**
- 5. Reduced frequency and intensity of disease**

Toxicology

In trials carried out no

- **Phytotoxic or**
- **phytopathogenic effects observed**

Biological Activity

- **Pluton stimulates the growth of roots, Increases the tolerance against abiotic stress and increases the yield of plants**
- **Trials have shown that auxins and other Plant hormones are produced by Pluton in The soil.**
- **Pluton produces a bio fertiliser effect which Is exerted by the enzyme Phytase.**

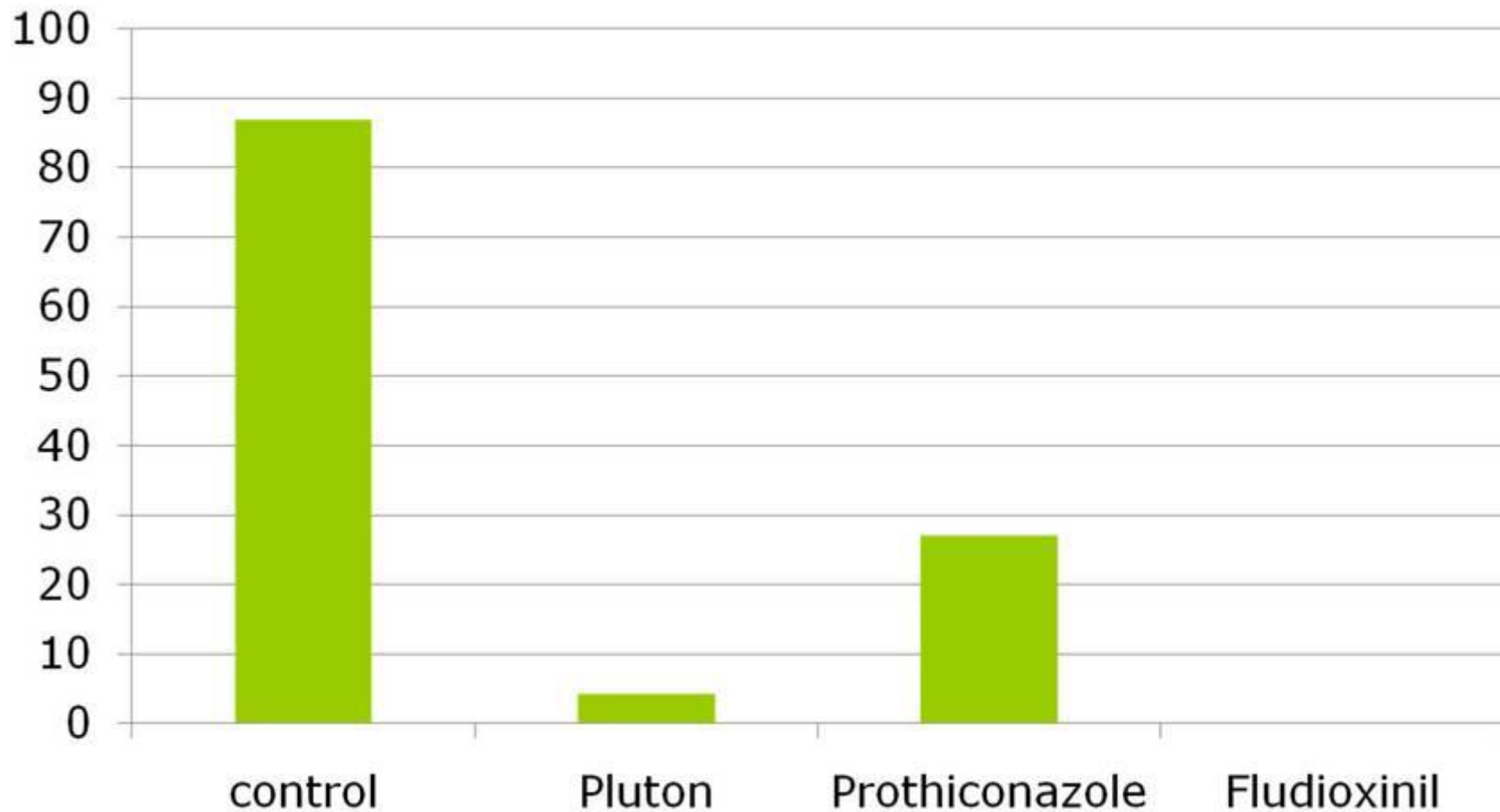
Rate of Use

- **Potatoes**- 250 g/ha. Applied through An Amistar type applicator.
Can also be injected with starter fertiliser
- **Other crops**(carrots, parsnips or onions, 250 g/ha.
Can be applied With pre emergence herbicide.



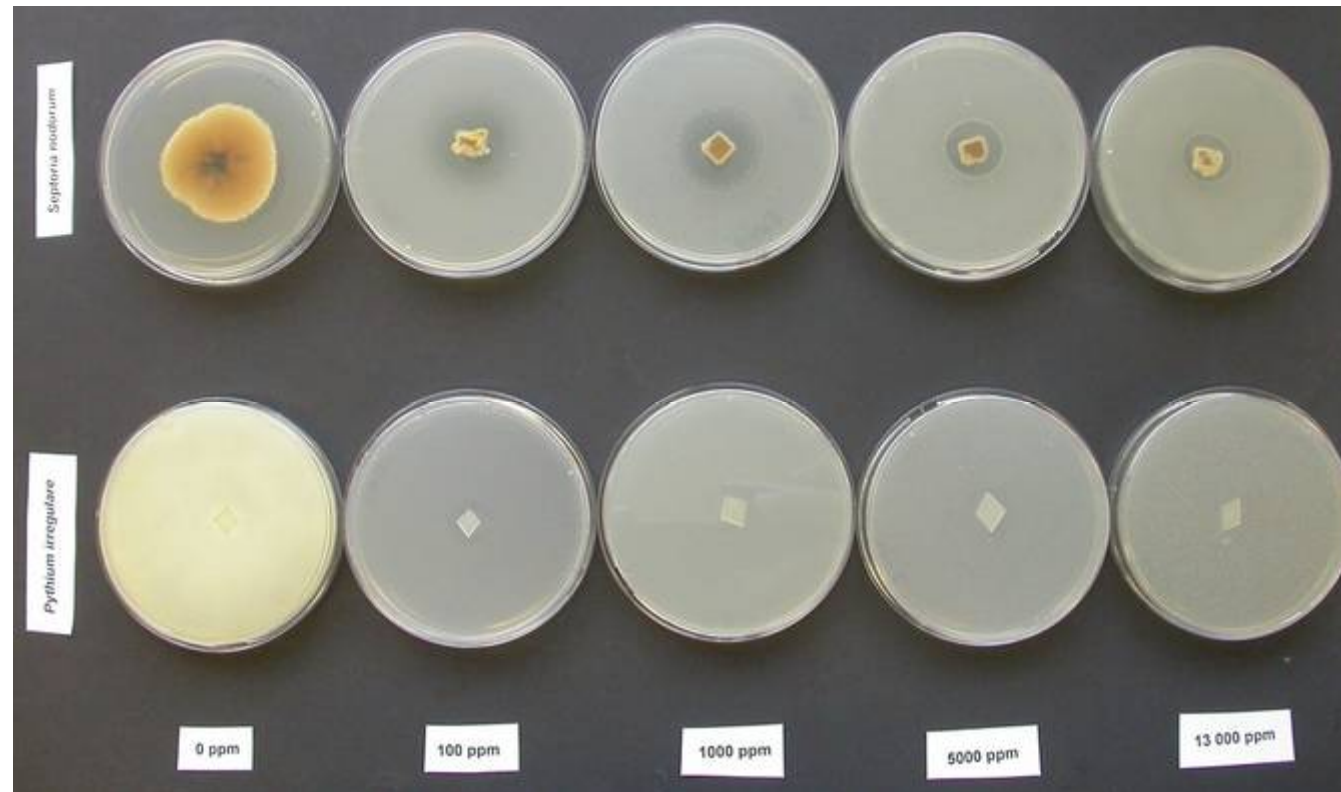
Trial Results

Effect of seed treatments on % infection with *Microdochium nivale*



Effect of Pluton on diseases Grown On agar plates

**Septoria
nodorum**



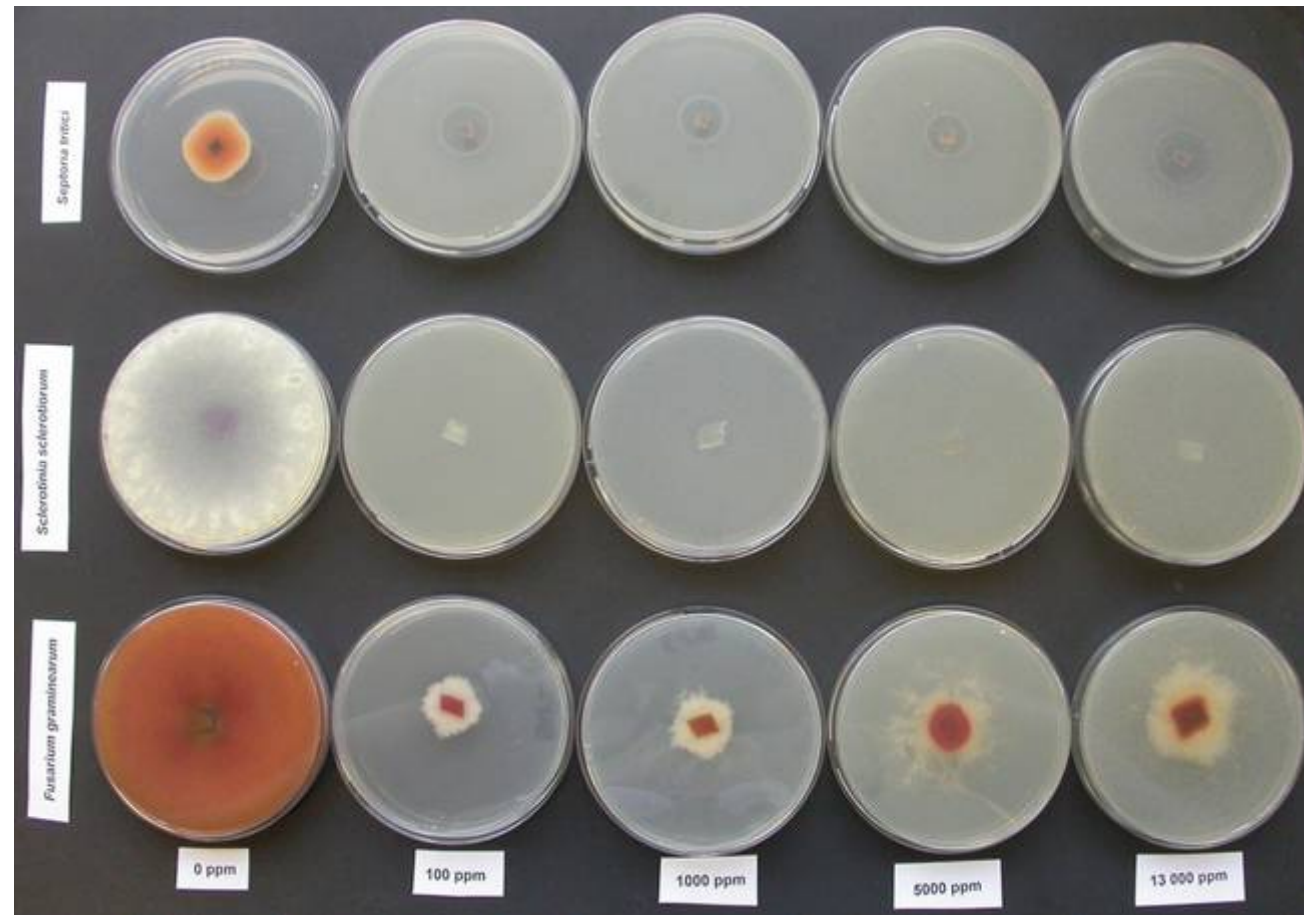
Pythium

Effect of Pluton on diseases Grown On agar plates

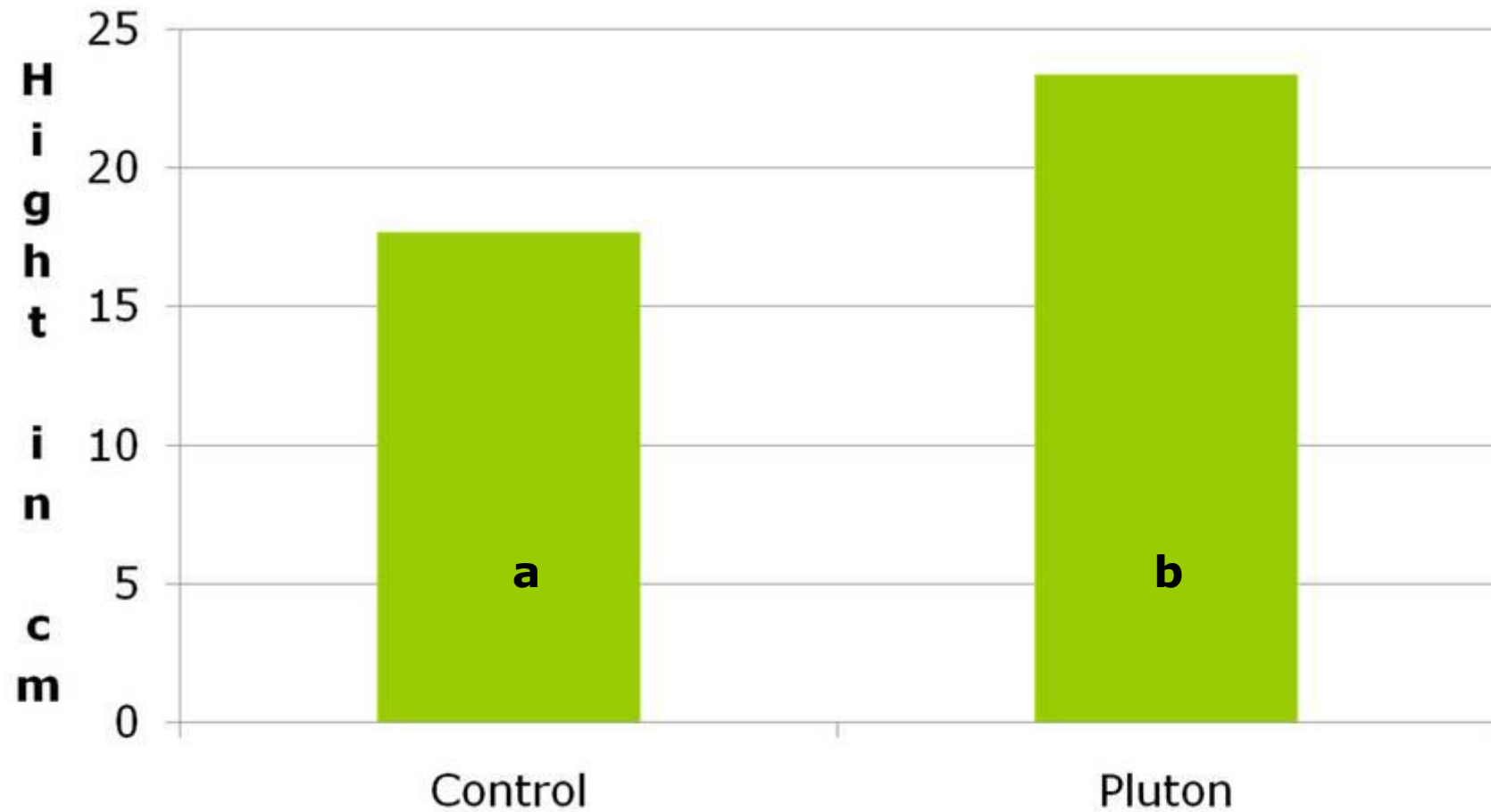
**Septoria
tritici**

Sclerotinia

Fusarium

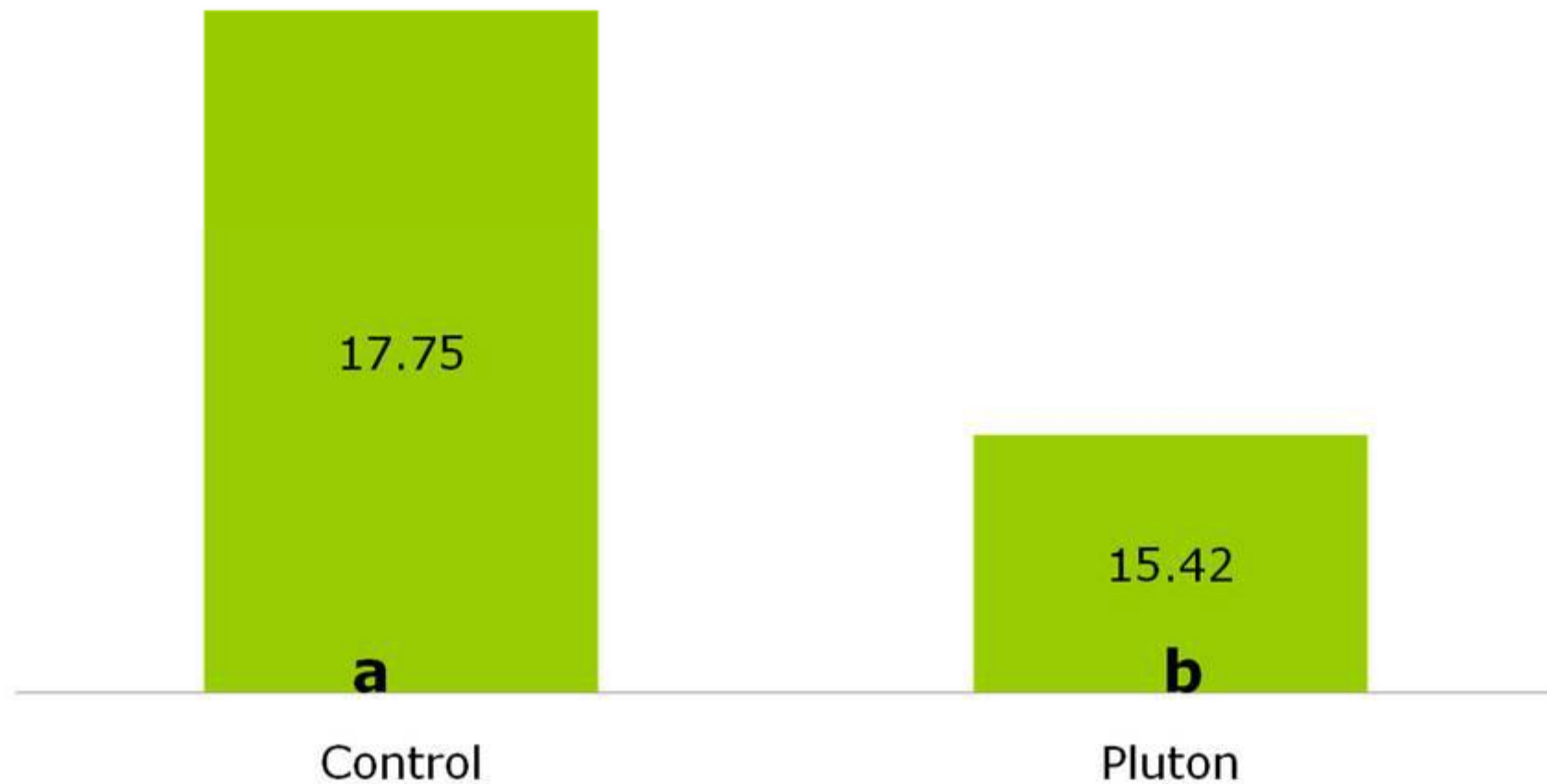


Effect Of Pluton on Ht of OSR. In Modules. 28 d post drilling.



Barworth Agriculture 2011

Effect of Pluton on Ht of Brassica Transplants 21 d Post Sowing

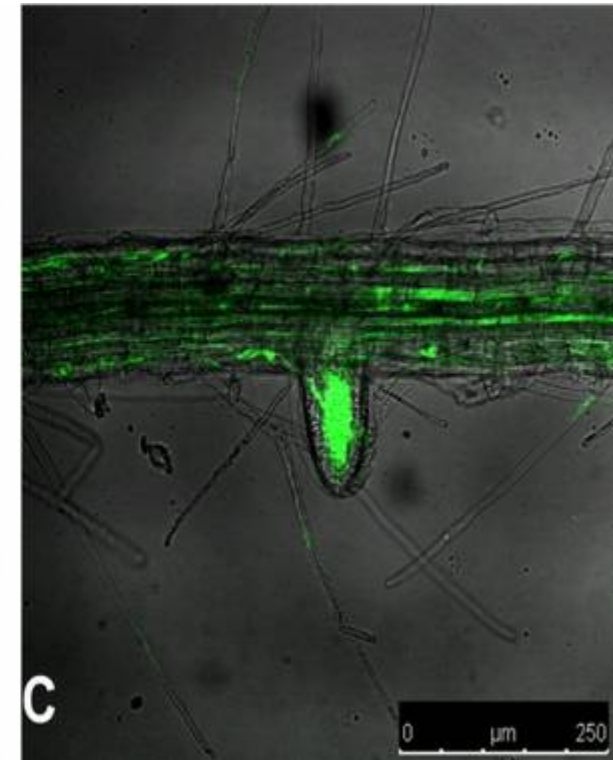
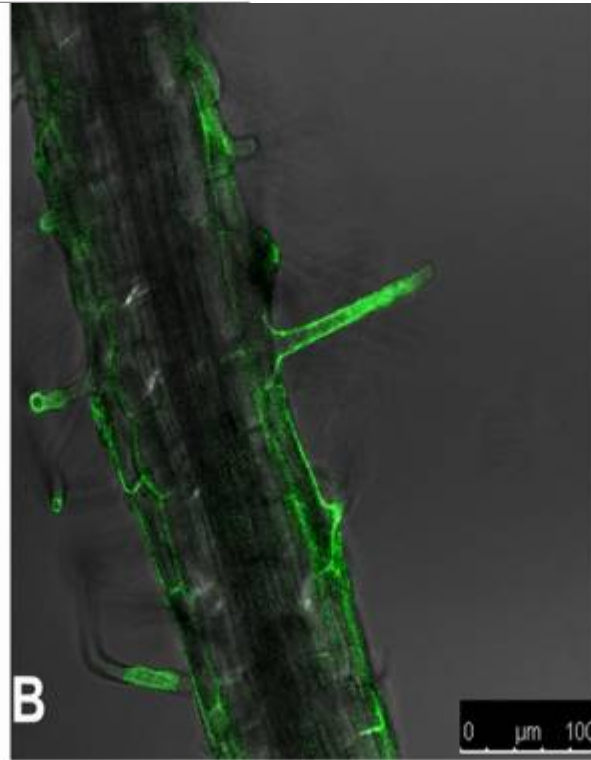
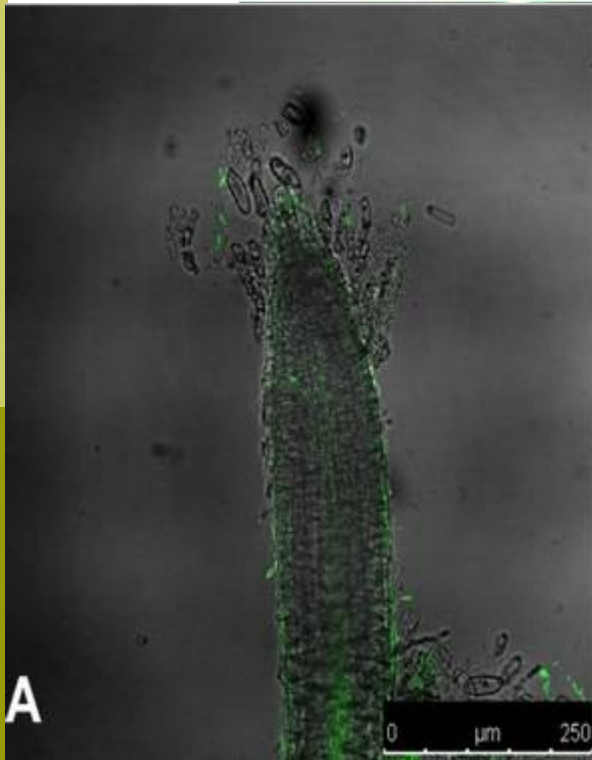


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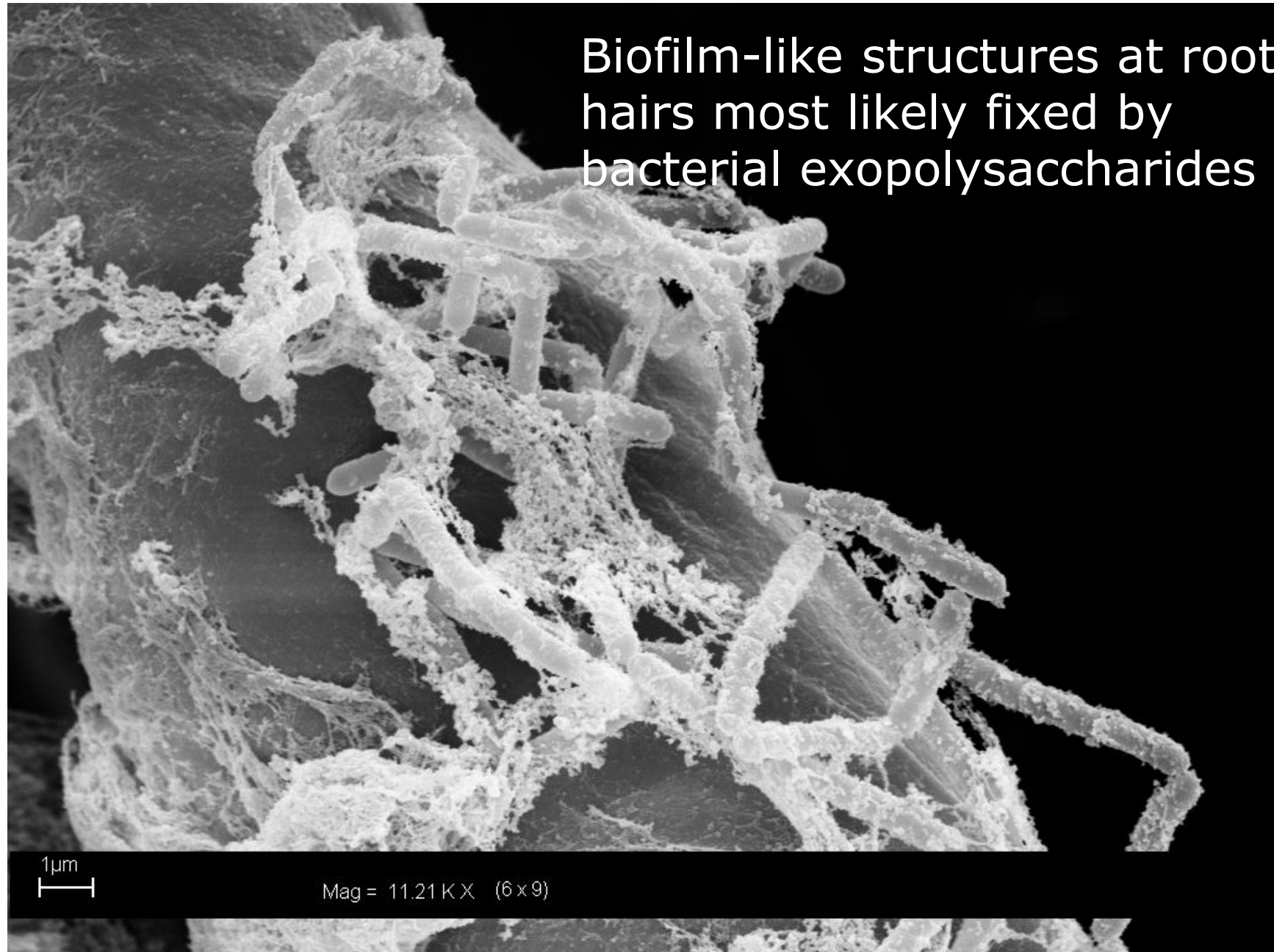
Mode of action

competition

- After use of *Bacillus* (by coating, soil drenching etc.) and germination of spores the roots will be colonized and will use sugars and amino acids for their growth



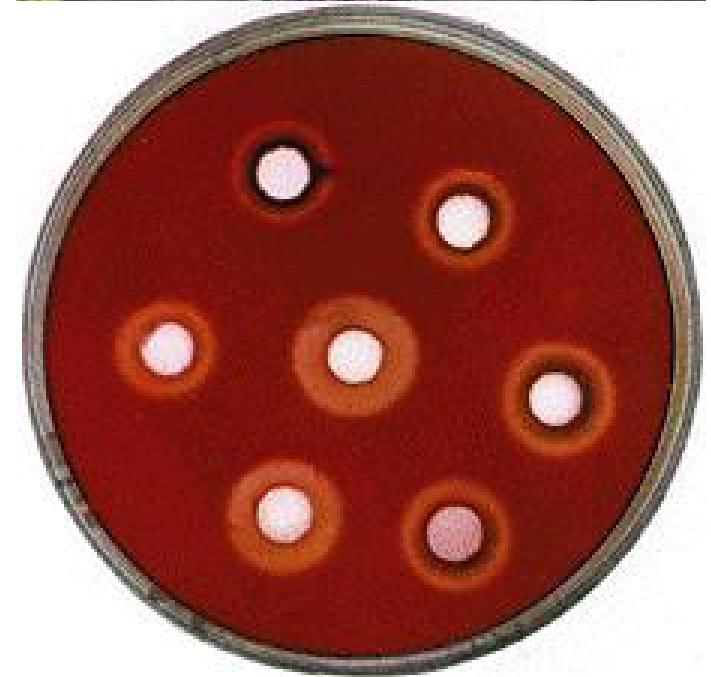
Biofilm-like structures at root hairs most likely fixed by bacterial exopolysaccharides



Mode of action

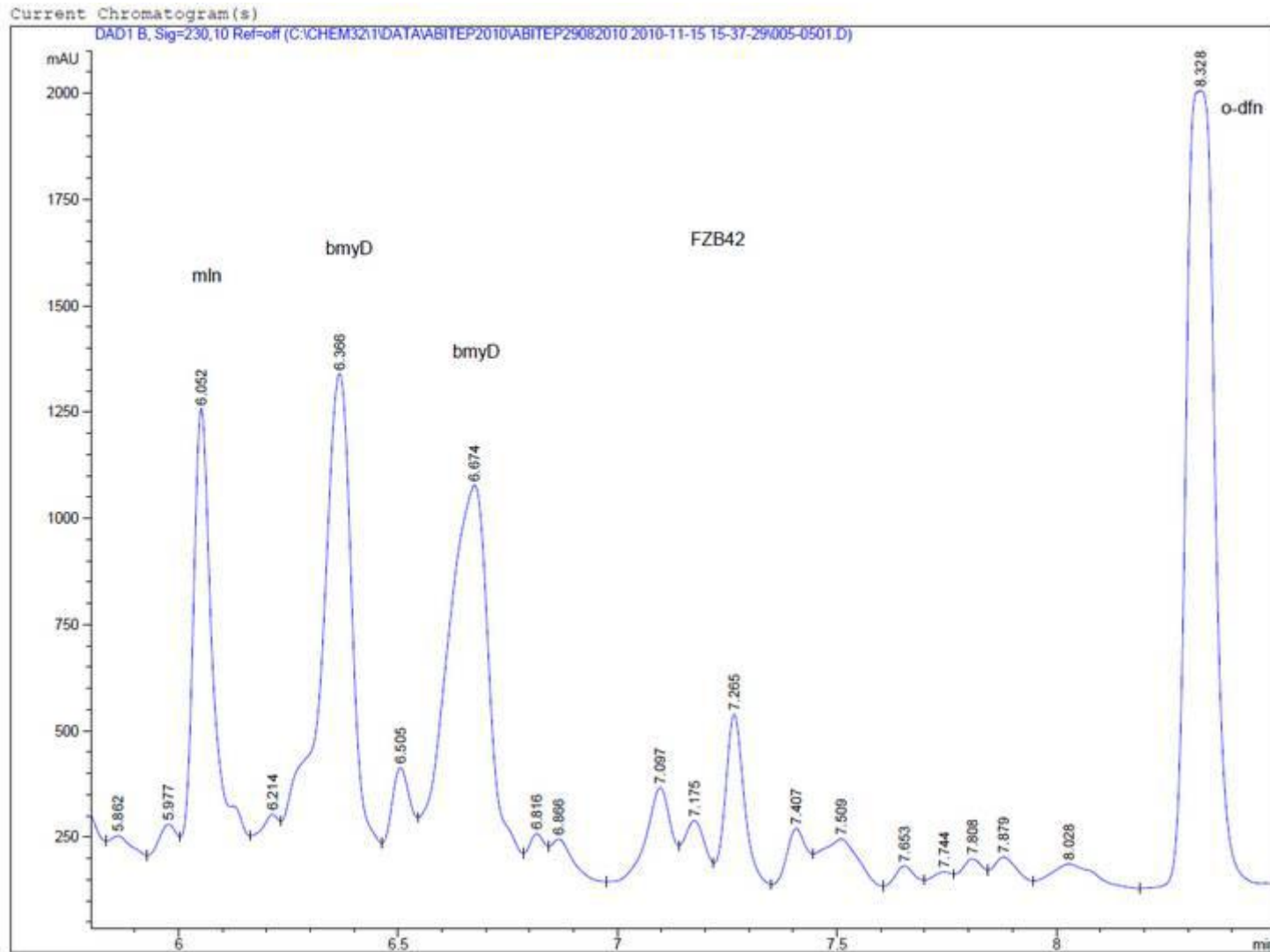
Growth promotion:

- Based on formation of growth hormones and enzymes for nutrient mobilisation
- **Growth hormones** (Auxines e.g.) support root formation
- **Enzymes** e.g. phytase transform organic phosphorous to anorganic phosphorous and in this way improve availability of nutrients for the plant





Antibiosis - One piece in the puzzle of the mode of action

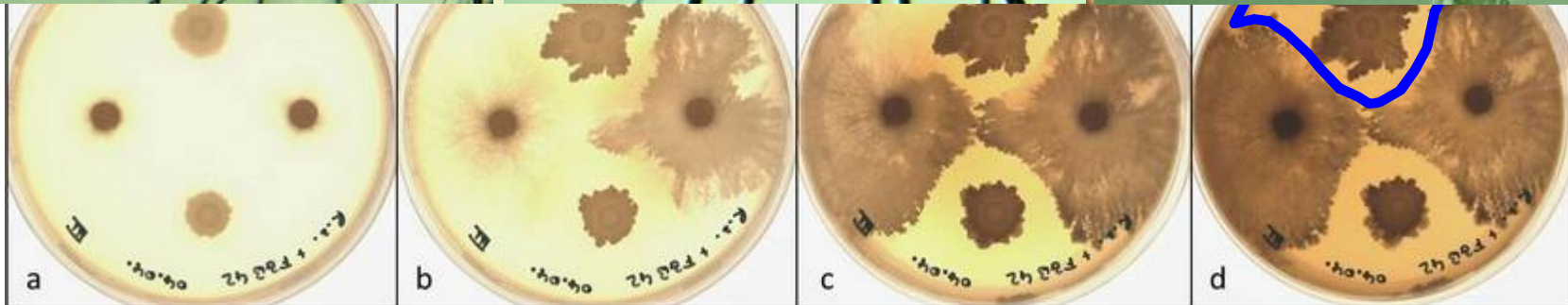
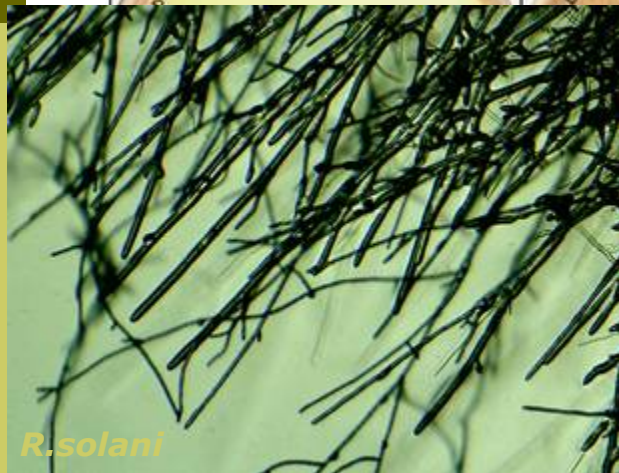




Antibiosis - One piece in the puzzle of the mode of action


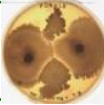


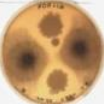


Cocultivation of *Rhizoctonia solani* and FZB42

Growth of *R. solani* in absence of FZB42



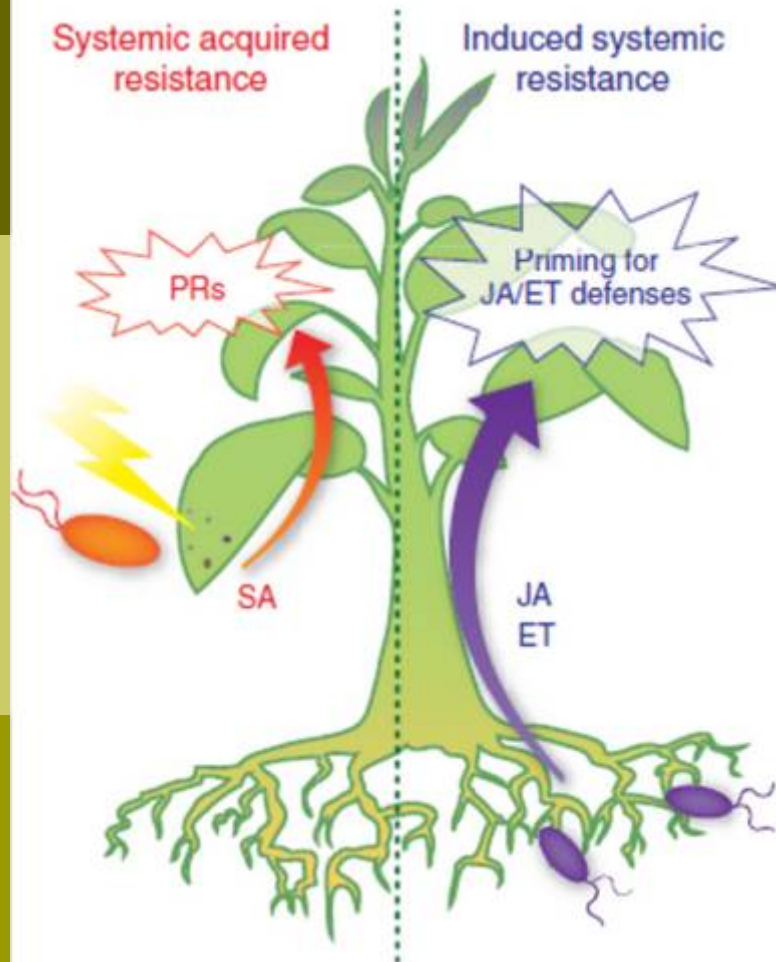


Antibiosis - One piece in the puzzle of the mode of action

FZB 42 mutant	Not produced	cocultivation	suppression
FZB42	./.		+
AK1	BacillomycinD		-
AK2	Fengycin		-
AK3	Bacillomycin D Fengycin		-
CH1	Surfactin		+
CH2	Fengycin Surfactin		-
Kontrolle (<i>R. solani</i>)	./.		./.



ISR - One piece in the puzzle of the mode of action

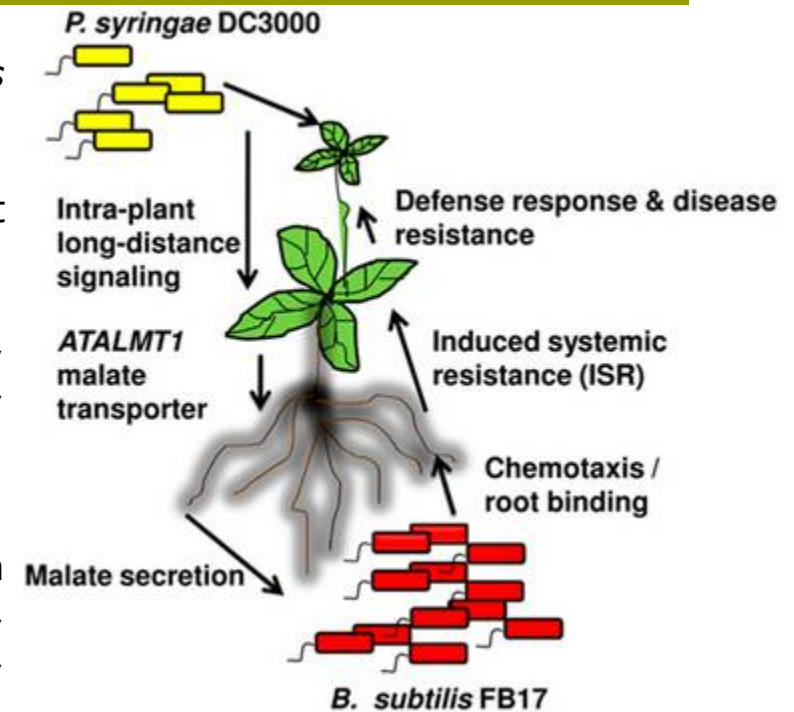


- Beneficial bacteria can stimulate an induced systemic resistance (ISR) in plants, whereby its defensive capacities are enhanced or “primed”.
- The ISR induced by beneficial bacteria is characterized by a weak, transient and localized defense response, but this priming leads to an enhanced expression of host defense related genes upon subsequent attack by a pathogen.
- The rhizobacteria typically induce ISR via induction of jasmonic acid (JA) and/or ethylene (ET) signalling pathways. However, some rhizobacteria appear to induce an SA-dependent pathway, indicating that different signaling pathways may operate when ISR is elicited.



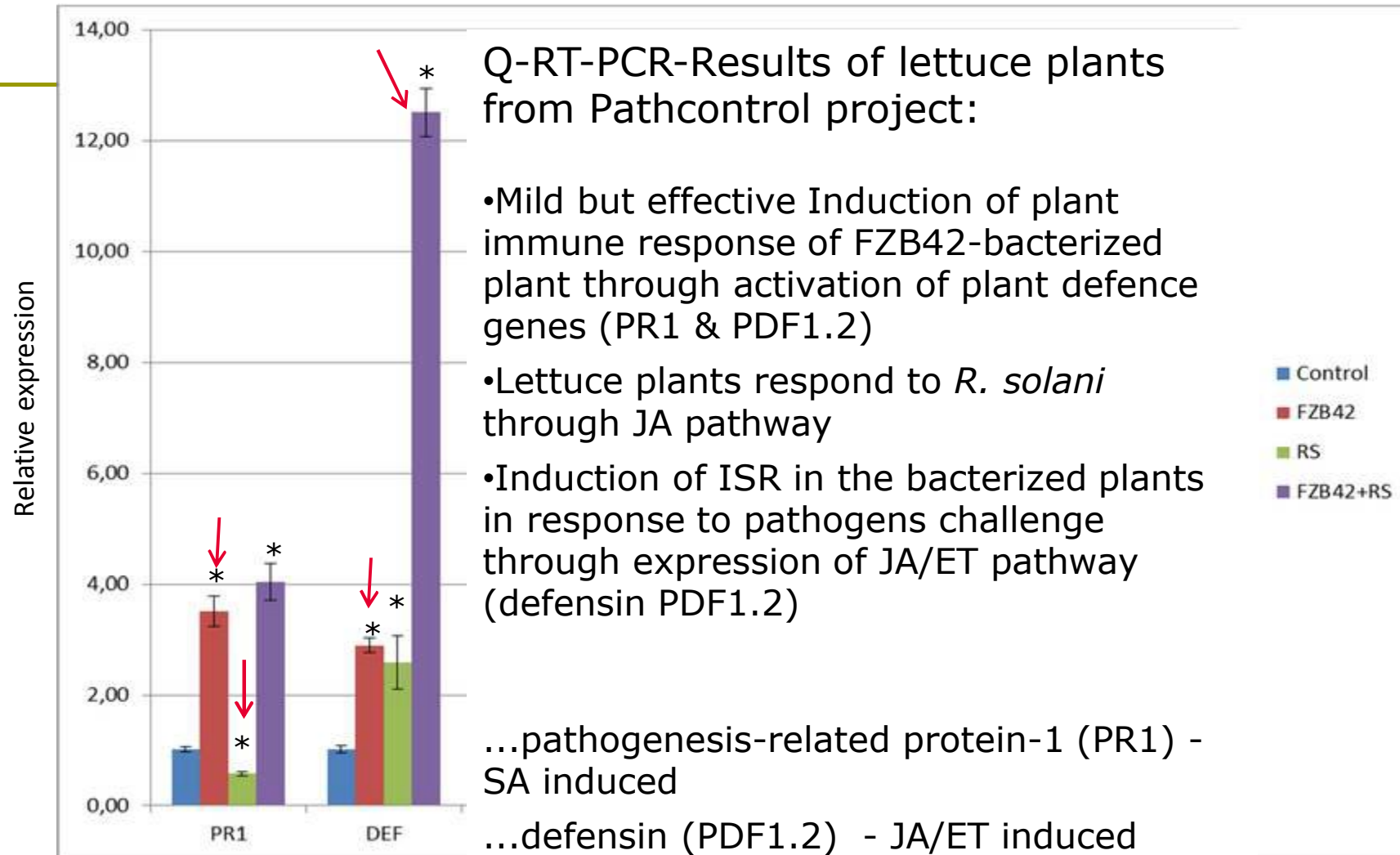
ISR - One piece in the puzzle of the mode of action

- Several reports have shown that various *Bacillus* strains are able to induce ISR in different plants.
- Molecular patterns (MAMPs) produced by *Bacilli* that are capable of eliciting immune responses in plants:
 - volatile organic compounds (Ryu et al., 2003, 2004; Rudrappa et al., 2010; Farag et al., 2013)
 - cyclic lipopeptides like surfactin and fengycin (Ongena et al., 2005b, 2007; Jourdan et al., 2009; Henry et al., 2011; Dessoignies et al., 2013)





ISR - One piece in the puzzle of the mode of action



* P < 0.001 ; § P < 0.005

Source: Soumitra Paul Chowdhury HGMU Munich