Soil suppressiveness to control the soil-borne fungal pathogen *Rhizoctonia solani*

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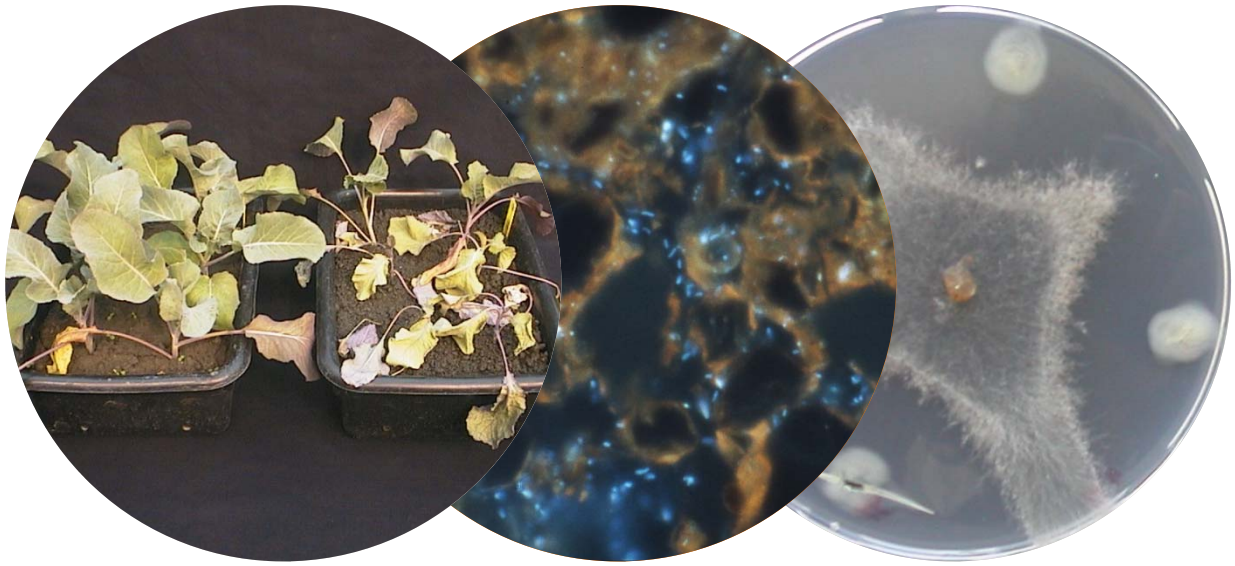

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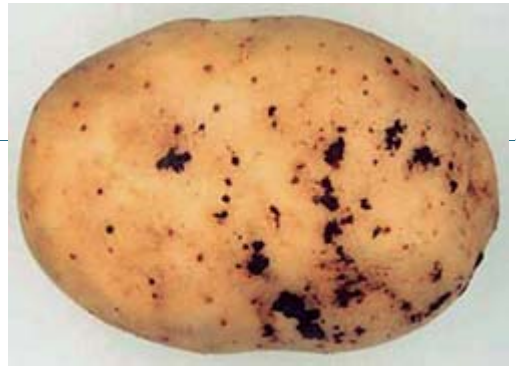
Rhizoctonia solani



- Pathogen in many different crops

  Potato, sugar beet, cabbage, carrot, wheat, lettuce, onion, tulip, lily, ….

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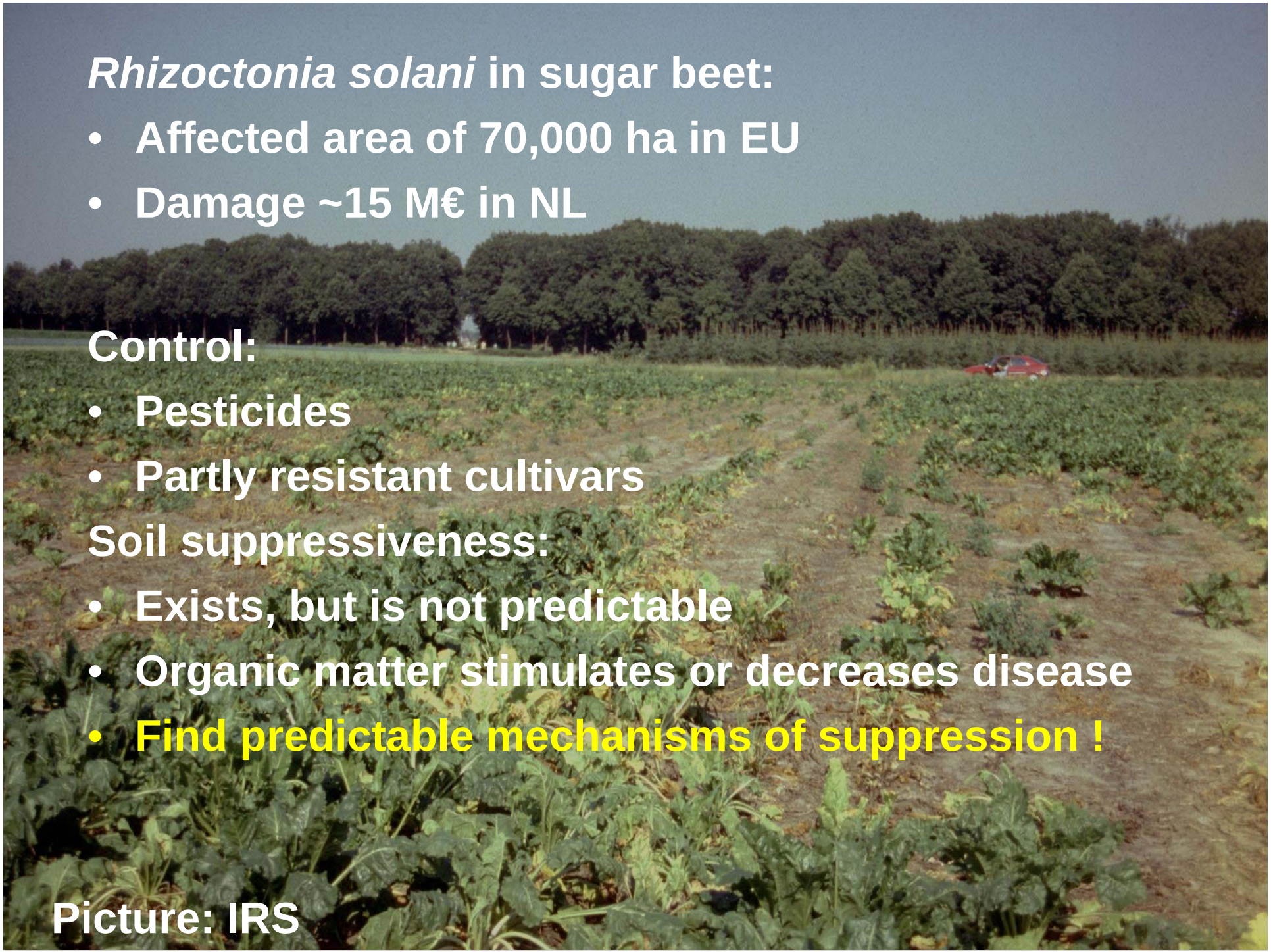


Rhizoctonia solani in sugar beet:

- Affected area of 70,000 ha in EU
- Damage ~15 M€ in NL

Control:

- Pesticides
- Partly resistant cultivars

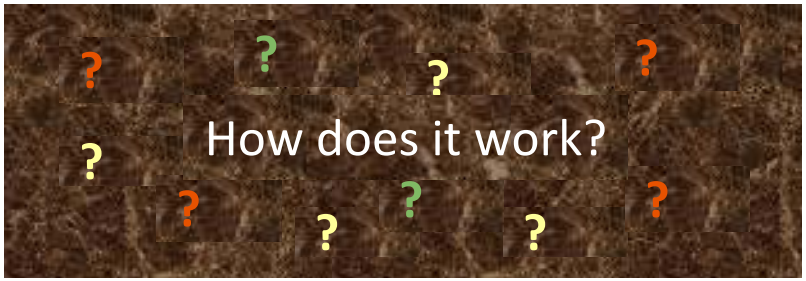
Soil suppressiveness:

- Exists, but is not predictable
- Organic matter stimulates or decreases disease
- Find predictable mechanisms of suppression !

Picture: IRS

Disease suppressive soils

- In a suppressive soil little crop damage will occur in a sensitive crop even in the presence of a pathogen
- Soil suppressiveness is regularly described for *Rhizoctonia solani*
- Mechanisms of suppression are not well understood yet



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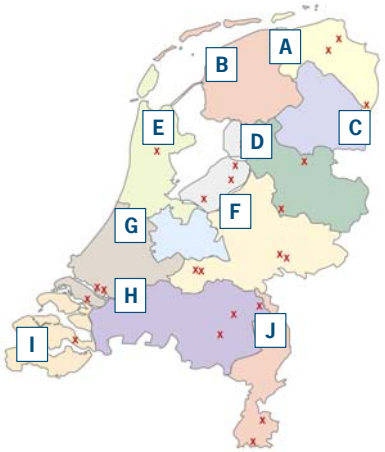
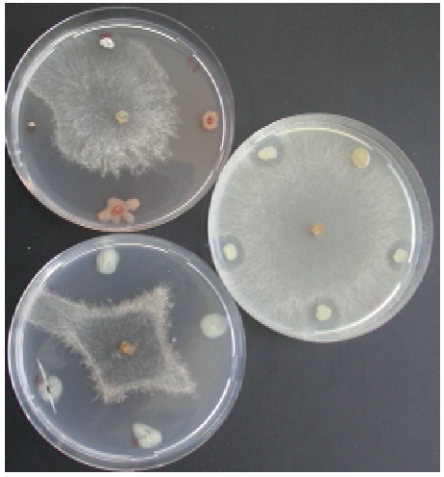
Rhizoctonia suppressive soil

- Organic matter and compost have no robust positive effect on disease suppression of *Rhizoctonia solani*
- Research: different soils in NL were compared for *Rhizoctonia* suppressiveness & correlating soil factors
- Interesting bacterial group: *Lysobacter* spp. correlated with occurrence of *Rhizoctonia* suppression (50% expl.)





Lysobacter characteristics

- 3 related species: *L. antibioticus, capsici, gummosus*
- Inhibition of several fungi, oomycetes, bacteria
- Production of several enzymes: chitinase, glucanase, protease, lipase
- Growth on biomacromolecules
- Lysis of bacteria, fungi, yeasts, algea, nematodes

QUESTION:

How can we stimulate antagonistic *Lysobacter* spp.??

Stimulation of *Lysobacter* & suppression

Experiments

1. Soil (Zwaagdijk) with naturally present *Lysobacter* & amendment of different organic compounds
2. Different soils & amendment with selected effective compounds

Analysis

1. Disease suppression in a bioassay
2. Quantification of *Lysobacter* with qPCR (TaqMan)

Bioassay for disease suppression

- Controlled climate
- Controlled water potential
- Treated soil samples – enrichment with different organic compounds
- Sugar beet seeds in a row
- *Rhizoctonia solani* AG2.2IIIB in front of the row
- Measure disease spread
- Take soil samples

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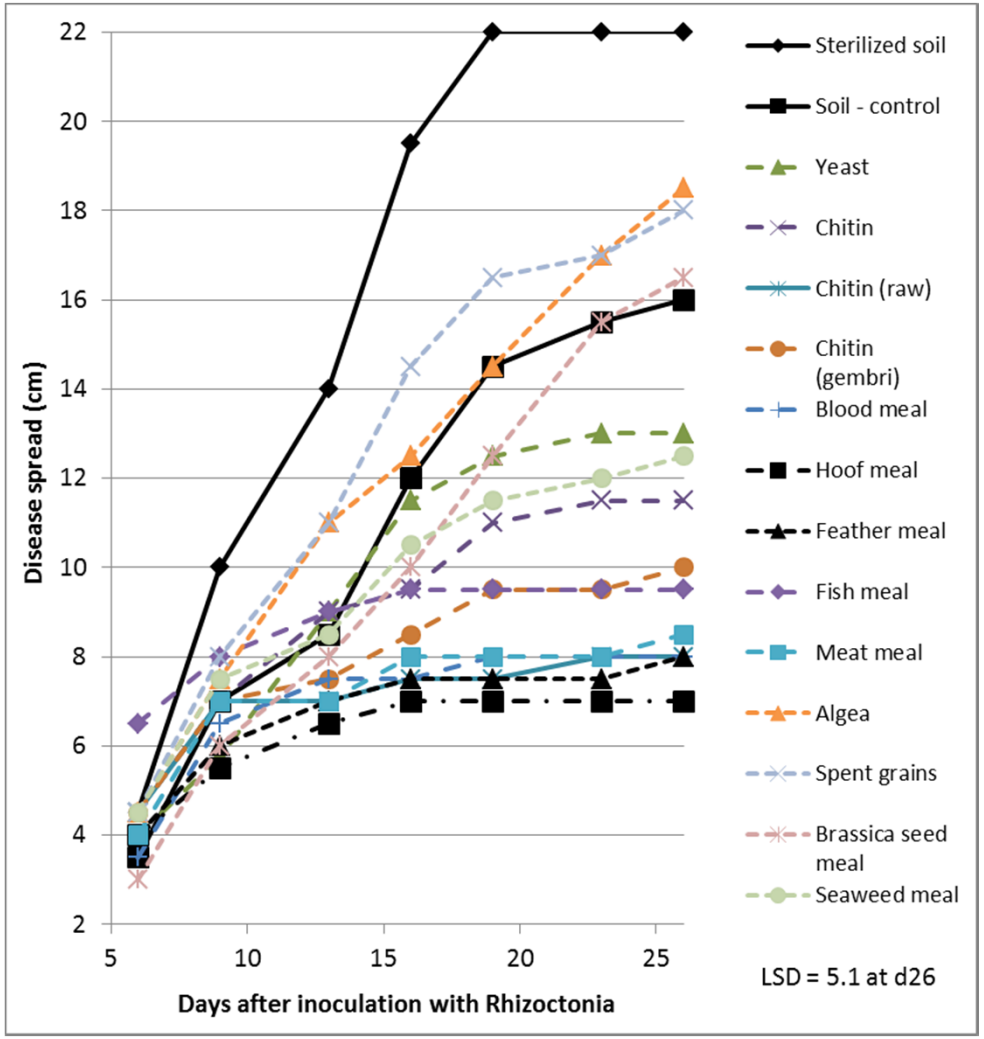
Different organic amendments

- Reduced *Rhizoctonia* spread = enhanced disease suppression
- Stimulation of natural occurring *Lysobacter* spp.
- Yeast, chitin, animal waste products
- Hoof and feather meal are cheapest most effective



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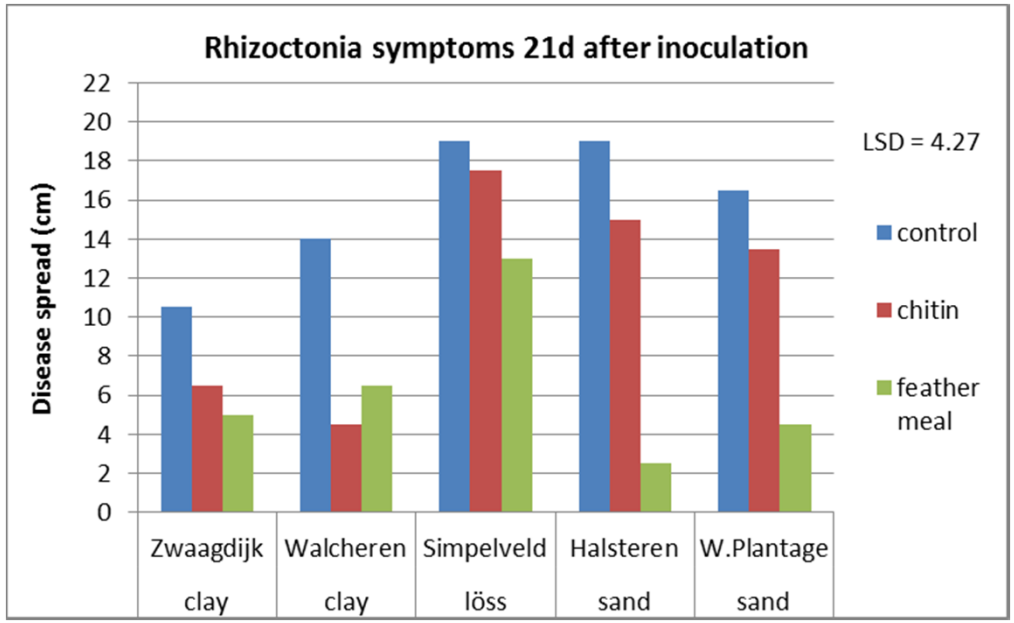
Different soils

- Without amendment: clay is more suppressive than sand and löss
- Enhanced suppression in clay soils with chitin & feather meal
- Enhanced suppression in sand soils with feather meal
- No/little enhanced suppression in löss



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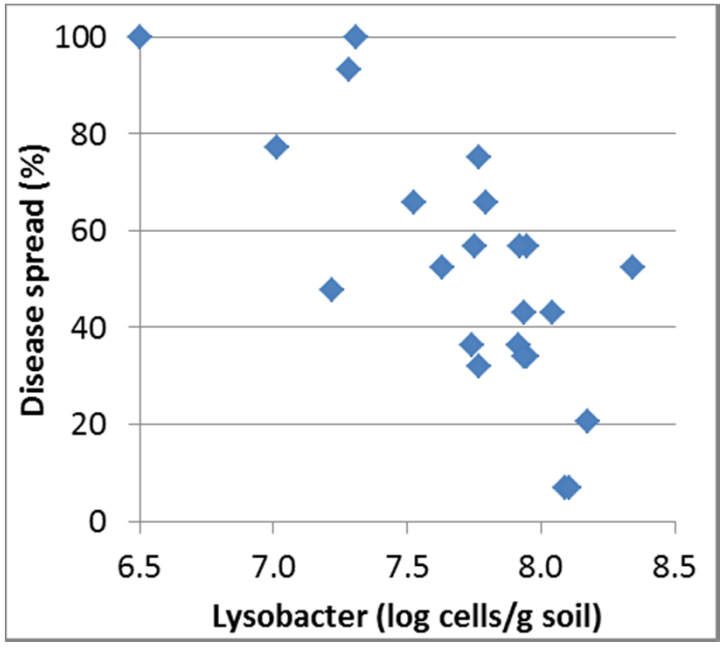
Mechanism of disease suppression

- *Lysobacter* is strong inhibitor of *Rhizoctonia* growth *in vitro*
- Correlation with *Lysobacter* populations in soil
- Causality is not proven !!
- Also other MO are stimulated
- Difficult to prove mechanism: sterilized soil give variable results, other MO also killed, recolonization with MO
- Combination of mechanisms?



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Field application

Cheap protein-rich animal waste products :

- As fertilizer with by-effect disease suppression
- With the aim to enhance disease suppression

Many questions:

- How to apply, effective dosage, time of application?
- How long does disease suppression remain?
- When can it be applied in the rotation? Previous crop?

Field experiment 2012

- Performed by Sugar beet Research Institute (IRS)
- In 2 fields with different soil types
- Natural infested fields of farmers
- Effect of chitin, feather and hoof meal on disease & harvest
- Low application dosage during sowing (50 kg/ha) – see photo
- Additional funding from SKB


Photo IRS


Photo IRS

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Results

- No effect on germination
- Little *Rhizoctonia*, no visible crop differences
- Soil samples are taken for *Lysobacter* detection (on going)
- Roots to be assessed for symptoms (on going)
- Yield to be assessed (on going)

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Conclusions

- Several organic compounds enhance *Rhizoctonia solani* suppression in repeated bioassays with sugar beet
- Effective waste products: cheap hoof & feather meal, or more expensive chitin
- Effective in different soil types (not in löss ?)
- Efficacy on field scale: on going research

Future

- How to apply in practice – as IPM:
    1. Presence of suppressing factor (*Lysobacter*) ?
    2. Can it be stimulated ?
    3. Is crop – soil – environment suitable ?
    4. When to apply in the crop rotation ?
- Or as fertilizer with by-effect disease suppression
    1. How long does suppression last?
    2. Can product be added in the previous corp?
- Efficacy against *Rhizoctonia* in other crops?

Thank you for your attention

Time for questions

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