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

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Rhizoctonia solani

- Pathogen in many different crops
  Potato, sugar beet, cabbage, carrot, wheat, lettuce, onion, tulip, lily, ....
*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!**
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.
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, algae, 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* AG2.2IIIIB in front of the row
- Measure disease spread
- Take soil samples
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
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
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?
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
Results

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

- Efficacy against *Rhizoctonia* in other crops?
Thank you for your attention

Time for questions