Rhizobium and antagonistic bacterial interactions with fungal pathogens in *Vicia faba*

S. Alström and B. Andersson
Inst. För skoglig mykologi och växtpatologi
A new 1-yr project

Outline

- **Multifunctional *Vicia* beans (field bean, broad bean)**
  - **source of different compounds**
  - **source of beneficial micro-organisms**
    - ***Rhizobium***
    - **Antagonistic bacteria**
    - **Arbuscular mycorrhizal fungi**
- **Fungal pathogens**
- **Hypothesis**
- **Work Plan**

Vicia bean

- a crucial break crop in organic farming
- Protein fodder
- mostly grown in southern and western Sweden
- their nutritional requirements and ability to fix N comparable to peas.
- can replace peas easily in a cereal-intensive farming on heavy clay soils if problems with pea root rot.
- Efforts made to develop new varieties with low tannin content

Source of
- rich in L-dopa, a substance used medically in the treatment of Parkinson's disease. L-dopa is also a natriuretic agent, which might help in controlling hypertension
- Areas of origin of the bean correspond to malarial areas. Some studies suggest that hemolysis due to favism acts as protection from malaria
- Raw beans contain the alkaloids which can induce hemolytic anemia in patients with the specific hereditary deficiency. This potentially fatal condition is called FAVISM.


Source of Beneficial microorganisms

***Symbiotic e.g. Rhizobium* spp** - live in symbiosis with legumes and forms toot nodules,
- **Primary** beneficial effect: Legumes can fix up to 300 kg N / year in symbiosis with rhizobia
- **Secondary** beneficial effects: some *rhizobia* can suppress plant pathogens. E.g. *Fusarium oxysporum, Rhizoctonia solani. (*Arfaoui et al 2006, Alström unpublished)

Nonsymbiotic e.g. Pseudomonas spp.
- Root associated, antagonistic to several pathogens, plant growth stimulation
Studies on effects of co-inoculation of *Rhizobium* sp. With antagonistic m.o. limited in Vicia beans. Rodelas *et al.* (1999).

Arbuscular mycorrhiza – in Vicia faba (*Glomus* spp.) in roots and nodules

---
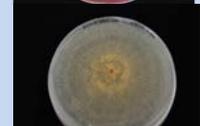
Several fungal diseases, particularly in Western Sweden.
Westman (2010) studied 14 fields in Öster- and Västergötland, highlights the importance of fungal associates for seed germination.
New experiences have reported a negative effect of short rotation on yield.

Two most serious pathogens:

1) Botrytis faba (= chocolate spot)
- aggressive in hot and humid weather, survives as mycelium or sclerotia on plant debris and in soil.

---

2) *Ascochyta faba* (causes Ascochyta blight, perfect stage *Didymella fabae*)
- seed borne, can survive on seeds up to 3 yrs and on the plant residues. Favoured by cool and damp weather.

Control Measures for both:
- Crop rotation with a minimum of 2 yrs break,
- thorough incorporation of crop residues to prevent the spread of spores to adjacent fields during the next spring,
- moderately dense populations, weed control, well-drained fields and
- well-balanced fertilization
- *Use of disease-free seeds for Ascochyta*

Lerenius, 2007
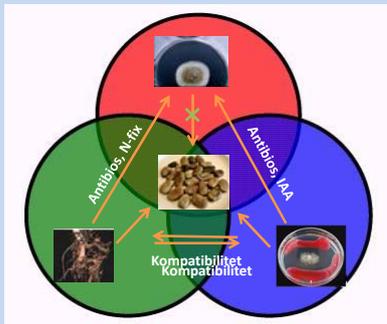
Hypothesis

- **The positive effects of multifunctional *Rhizobium* can be strengthened synergistically in the presence of antagonistic bacteria to get improved N - fixation, plant nutrition and disease protection as reward.**
- **Their synergism will reduce the spread of seed-borne fungi in field bean during the growing season and also reduce the levels of seed borne inoculum.**

Work plan
- isolation, purification and establish identity of the organisms
- investigations *in vitro*
    - pathogen inhibition using bioassays.
    - compatibility of *antagonist (s)* with *Rhizobium* spp
    - colonization competence of *antagonists* in comparison to *Rhizobium* sp.
- investigations in *vivo* effect of *Rhizobium* and antagonsitic bacteria with respect to
    - compatibility of *Rhizobium* with field bean plants
    - compatibility of *antagonists* with field bean plants
  - Effects on plant growth, N-fixation, nodulation
  - Effect on plant disease symptoms and development

TACK !!