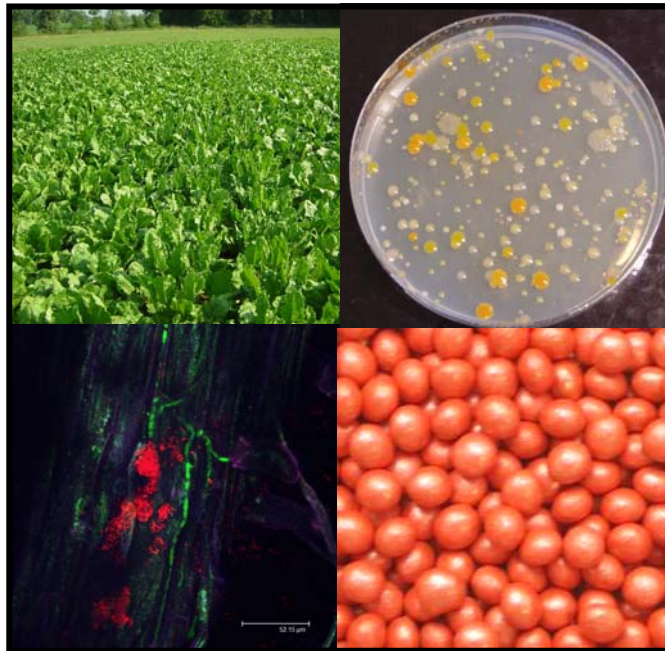


# Concepts of application of microbial consortia to control soil-borne pathogens



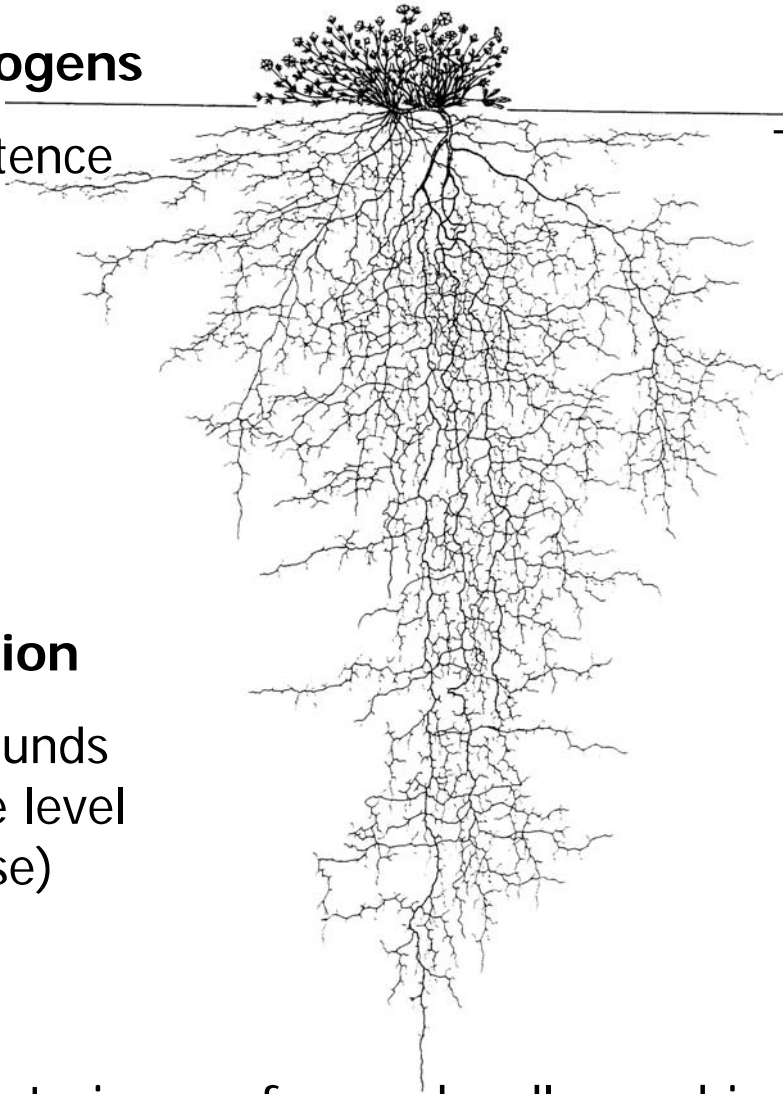
Henry Müller, Christin Zachow, Ralf Tilcher, Gabriele Berg



# Functions of beneficial plant-associated microbes

## Repression of pathogens

Colonization competence  
Competition  
Lysis  
Antibiosis



## Immunization

Triggering plant's defence mechanisms  
(Induction of resistance)

## Stress protection

Protective compounds  
Lowering ethylene level  
(ACC deaminase)

## Growth promotion

Phosphor solubilization  
Nitrogen fixation  
Growth hormones



One single bacterium or fungus hardly combines all these attributes

## Late root rot of sugar beet

- Caused by the soil-borne fungus *Rhizoctonia solani* AG2-2IIIB
- Infection of weak plants in late vegetation period
- High yield losses due to complete degradation of the sugar beet body



# Screening and selection procedure for biocontrol agents

## Sugar beet-associated microorganisms (autochthonous)

Bacteria (n=1952) and fungi (n=1344)



*Rhizoctonia* specific bacteria (n=53 + + +) and fungi (n=50 + + +)



No growth at 37°C: *Pseudomonas*: n=10 and *Trichoderma*: n=5



Characterization of enzymatic, metabolic activity, effects ad planta, colonization behaviour



*Pseudomonas trivialis* (endorhiza)  
*Trichoderma gamsii* (rhizosphere)

## Plant-associated microorganisms (allochthonous)

Strain Collection of Antagonistic Microorganisms (SCAM, TU Graz)



2 Potato-associated bacteria (rhizosphere)

*Pseudomonas fluorescens*  
*Serratia plymuthica*

+

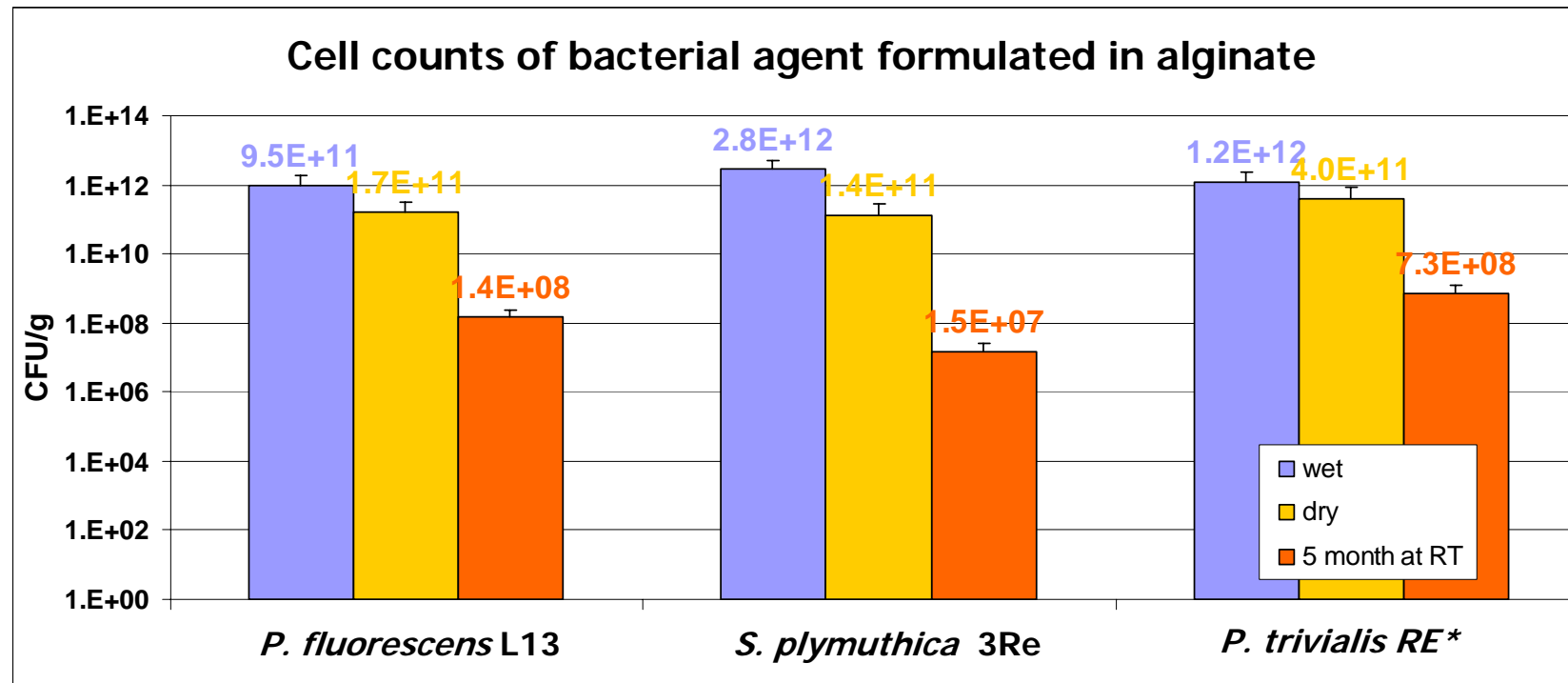
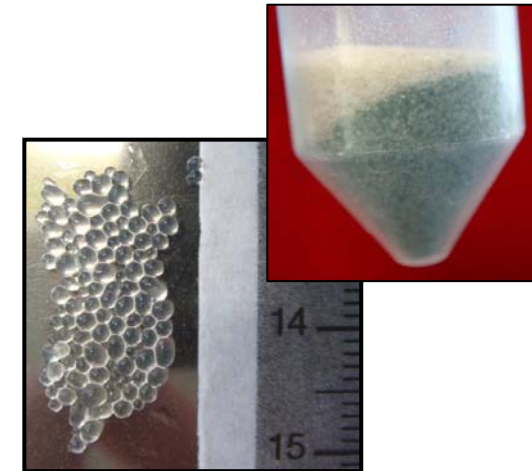
2 *Rhizoctonia* sclerotia-associated fungi on potato

*Trichoderma velutinum*  
*Trichoderma viride*

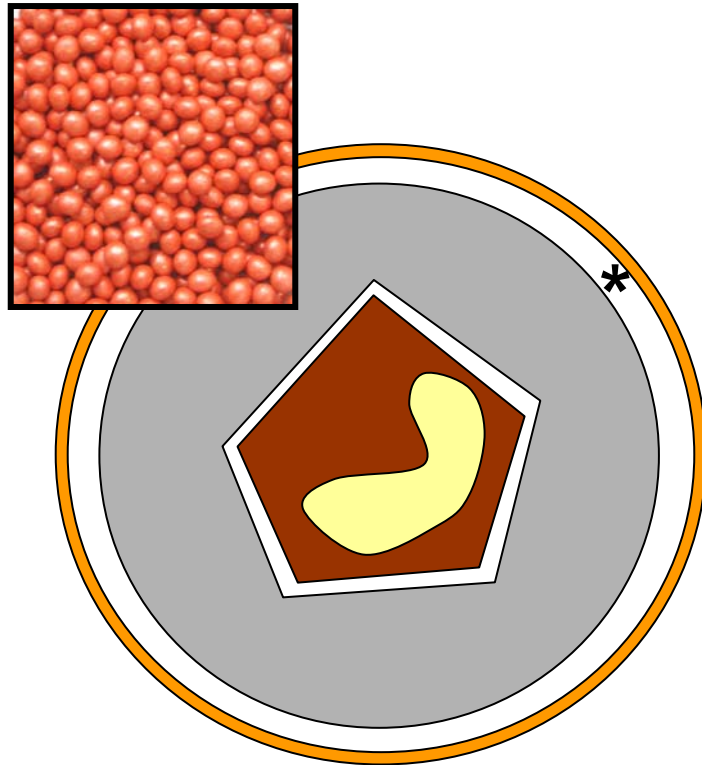


# Formulation of three bacteria and one Trichoderma strain

- Combined encapsulation in an alginate hydrogel
- Addition of protective substances compatible with all bacterial and fungal biocontrol agents
- Drying and storage at room temperature



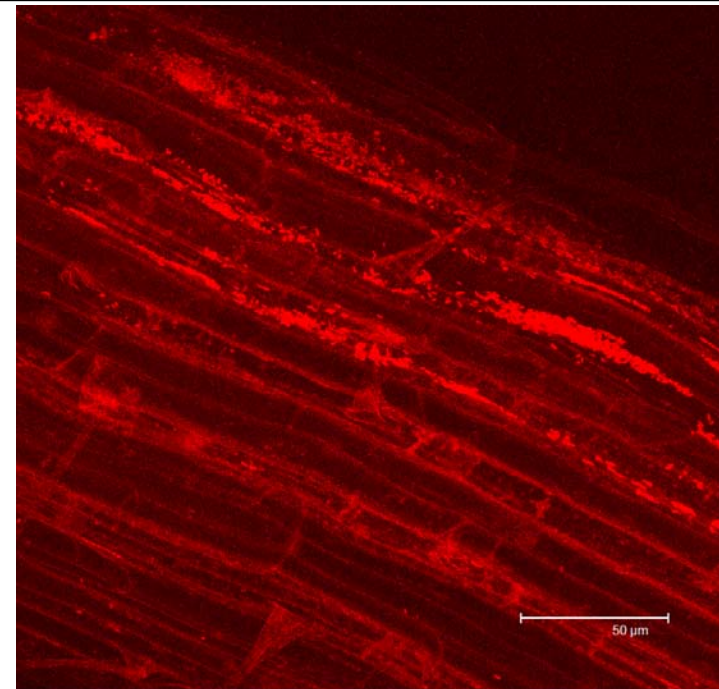
# Application of the biocontrol agents to sugar beet seeds



Structure of sugar beet seeds  
([www.kws.de](http://www.kws.de))

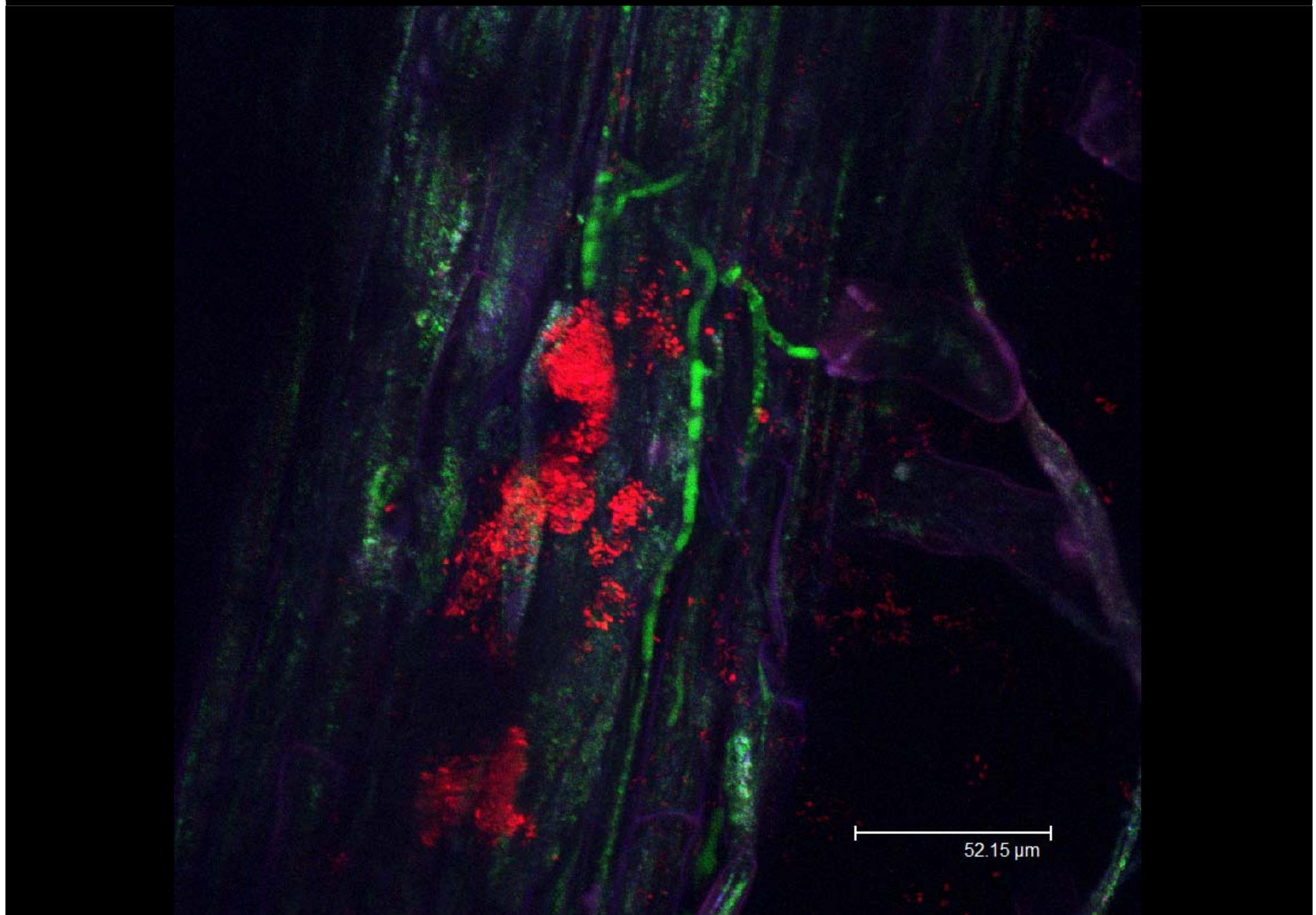
\* Application of the microorganisms  
around the sugar beet seed

Spreading out of the microorganisms via  
the germinating root



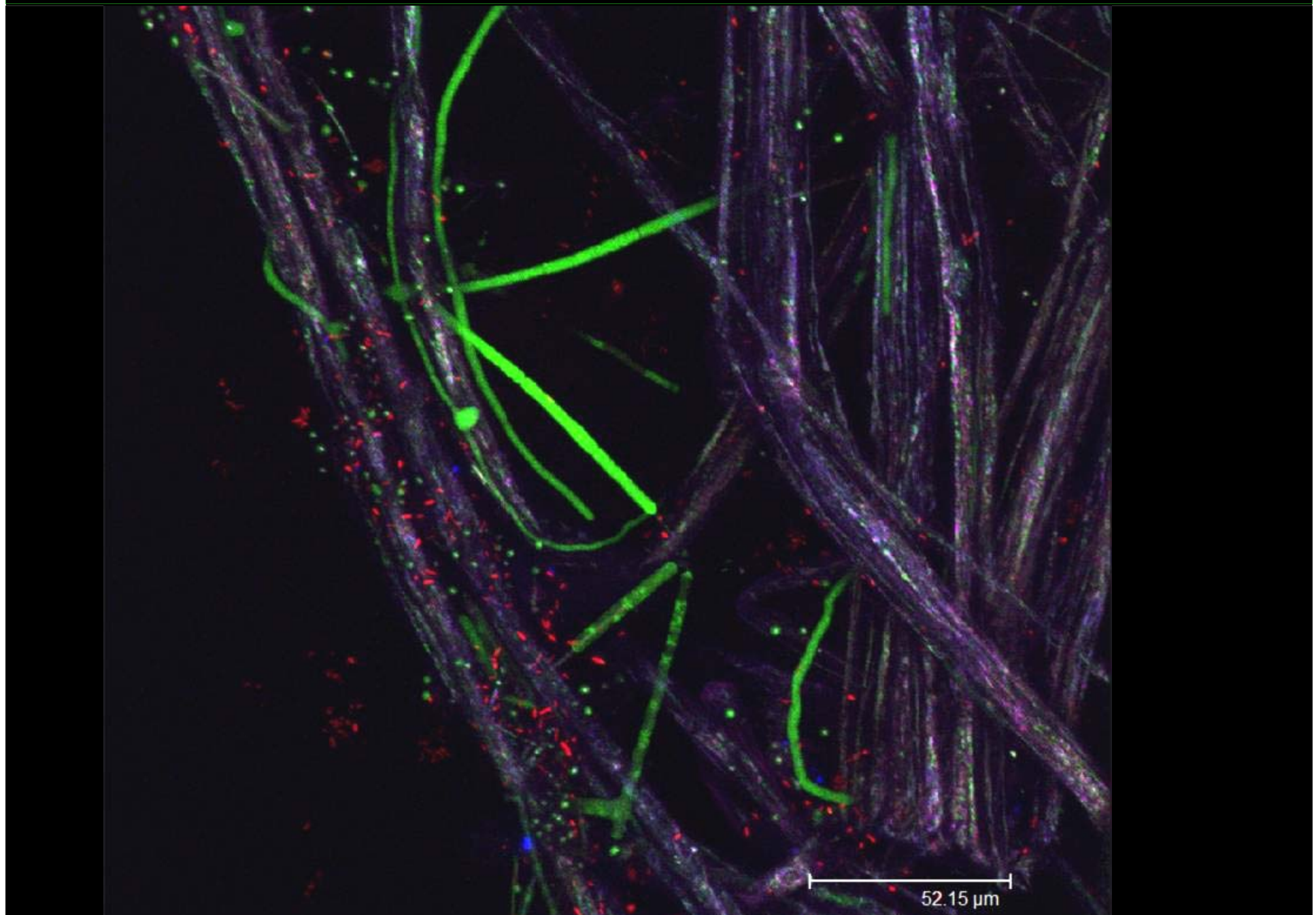
Protection of the sugar beet plants against the  
pathogen *Rhizoctonia solani*

*P. fluorescens* and *T. velutinum* (CLSM)





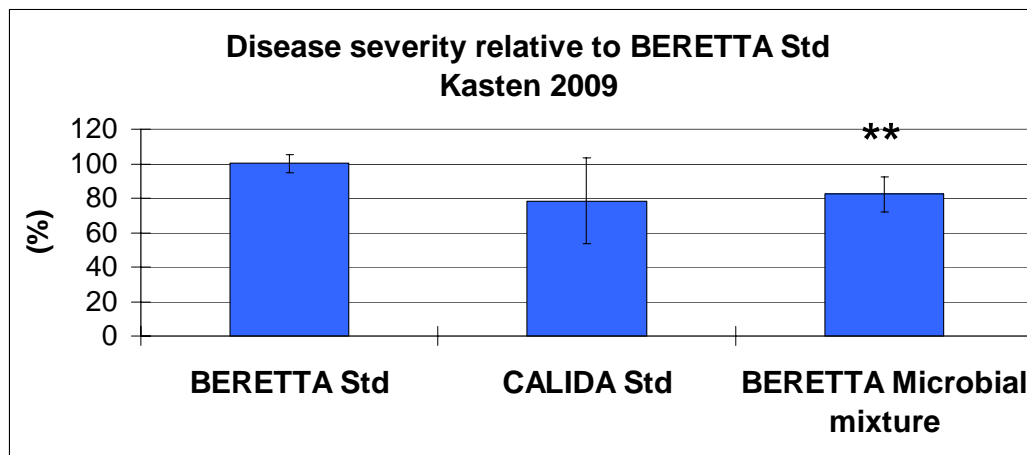
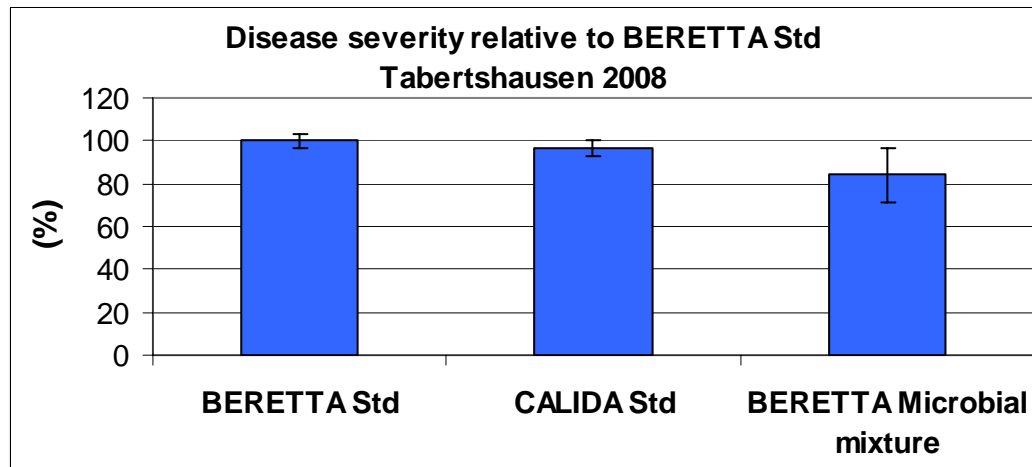
*P. fluorescens* and *T. velutinum* (CLSM)





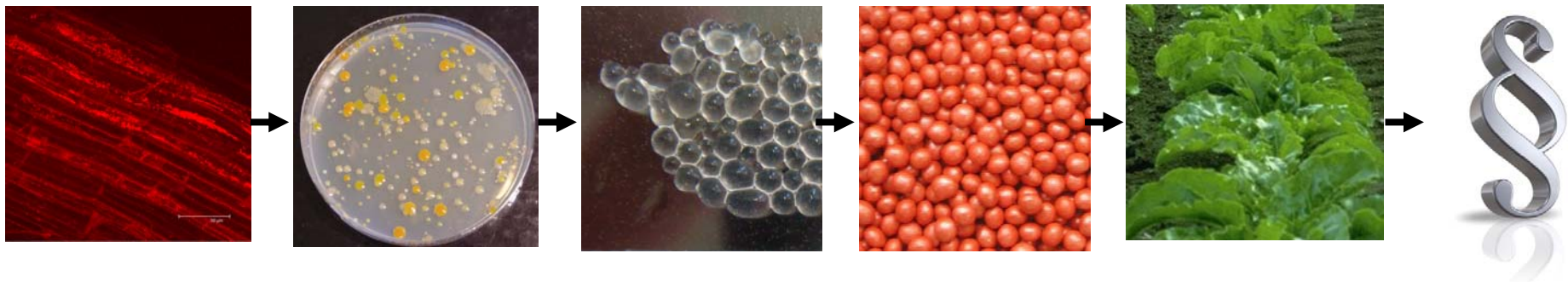
# Field trials in Lower Bavaria, Germany

- Plot trials with *R. solani*-inoculated soil
- BERETTA *R. solani* susceptible cultivar
- CALIDA *R. solani* tolerant cultivar



# Summary

- Beneficial microbes fulfill manifold function in/on plants
- Compilation of a microbial consortium based on origin and mode of action to control *R. solani* on sugar beet
- Combined formulation in calcium-alginate
- Application to seed coating of sugar beet
- Consistent positive effects on disease severity in field trials



- Perspectives for registration?



Thank you!



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