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EXCELLENCE FOR SUSTAINABILITY

Research Institute of Organic Agriculture
Forschungsinstitut für biologischen Landbau
Institut de recherche de l'agriculture biologique

Development of disease-suppressive organic growing media

J.G. Fuchs[1] , T. Hedrich[1,2], V. Hofer[1], M. Koller[1], T. Oberhänsli[1], J. Ribera Regal[3], L. Tamm[1], B. Thuerig[1], F.W.M.R. Schwarze[3], J. Herforth-Rahmé[1]

[1]FiBL, Research Institute of Organic Agriculture, Frick, Switzerland; [2]University of Geisenheim, Germany; [3]Empa Swiss Federal Laboratories for Materials Testing and Research, Applied Wood Materials, Switzerland

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Introduction: growing media

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- **Base for vegetable production: vigorous and healthy seedlings.**
- **Growing media play a decisive role.**
- **Two aspects are crucial:**
  - availability of nutrients in appropriate amounts
  - absence of active plant pathogens
- **Growing media are complex products with different properties:**
  - nutrient availability
  - plant disease suppression
  - water and air capacities
  - structure stability
  - pH-value
  - salt content
  - etc.

Introduction: growing media

- **Important challenge: capacity of a growing media to suppress plant diseases:**
  - condition: use of mixture components free from plant pathogens
  - microbiologically inactive components: conducive to pathogens
  - microbiologically active components: buffering media, preventing invasion with pathogens
  - another possibility: amendment with antagonistic microorganisms

- **Aim of this study**
  - Characterization of the influence of different kinds of amendments of growing media on the development of plant diseases (i) and testing the effect of an inoculation of *Trichoderma* strains on the plant's protection against pathogens (ii)

Material and methods

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- **Disease suppressiveness of growing medias:**
  - *Pythium ultimum* - cress (*Lepidium sativum*)
  - *Pythium ultimum* - cucumber (*Cucumis sativus*)
  - *Rhizoctonia solani* - basil (*Ocimum basilicum*)
  - Biotests under controlled conditions with artificial inoculation of the pathogens
    - day / night lengths: 16 hours (23˚C) / 8 hours (18˚C)
  - Biotests evaluation
    - cress: shoot biomass was determined after 6 days
    - cucumber: number of living plants, shoot and root biomass after 14 days
    - basil: shoot biomass and mortality of the plants after 4 weeks

Material and methods

- **Substrates used for the production of growing media:**
  - Black and white peat
  - Wood fibers
  - Cocos coir
  - Compost
  - Digestate
  - Fertilization (except compost and digestate): 0.3g N, 0.1g P_2O_5, and 0.4g K_2O per liter

- **Nitrogen fertilizers used :**
  - Horn powder (standard fertlizer)
  - Biosol (contains 40% of chitin, promotes microorganisms decomposing fungi)
  - Shrimps shells (chitin)
  - Castor oil cake (ricin)

Material and methods

› Microbial biocontrol agents tested:

- Commercial products
  - *Bacillus subtilis* (Serenade Max, Stähler)
  - *B. amyloliquefaciens* (AmyloX, Biogard)
  - *Pseudomonas fluorescens* (Biofitac Pf1, Biophyt AG)
  - *Gliocladium catenulatum* J1446 (Prestop, Andermatt Biocontrol)
  - *Trichoderma harzianum* (Trianum, Koppert)

- Strains in development
  - *Trichoderma harzianum* 720 (EMPA, CH-St. Gallen)
  - *Trichoderma harzianum* 721 (EMPA, CH-St. Gallen)
  - *Trichoderma atroviride* 685 (EMPA, CH-St. Gallen)
  - *Trichoderma atroviride* 722 (EMPA, CH-St. Gallen)
  - *Trichoderma koningiopsis* 723 (EMPA, CH-St. Gallen)

Influence of fertilizers and peat substitutes on disease suppressiveness

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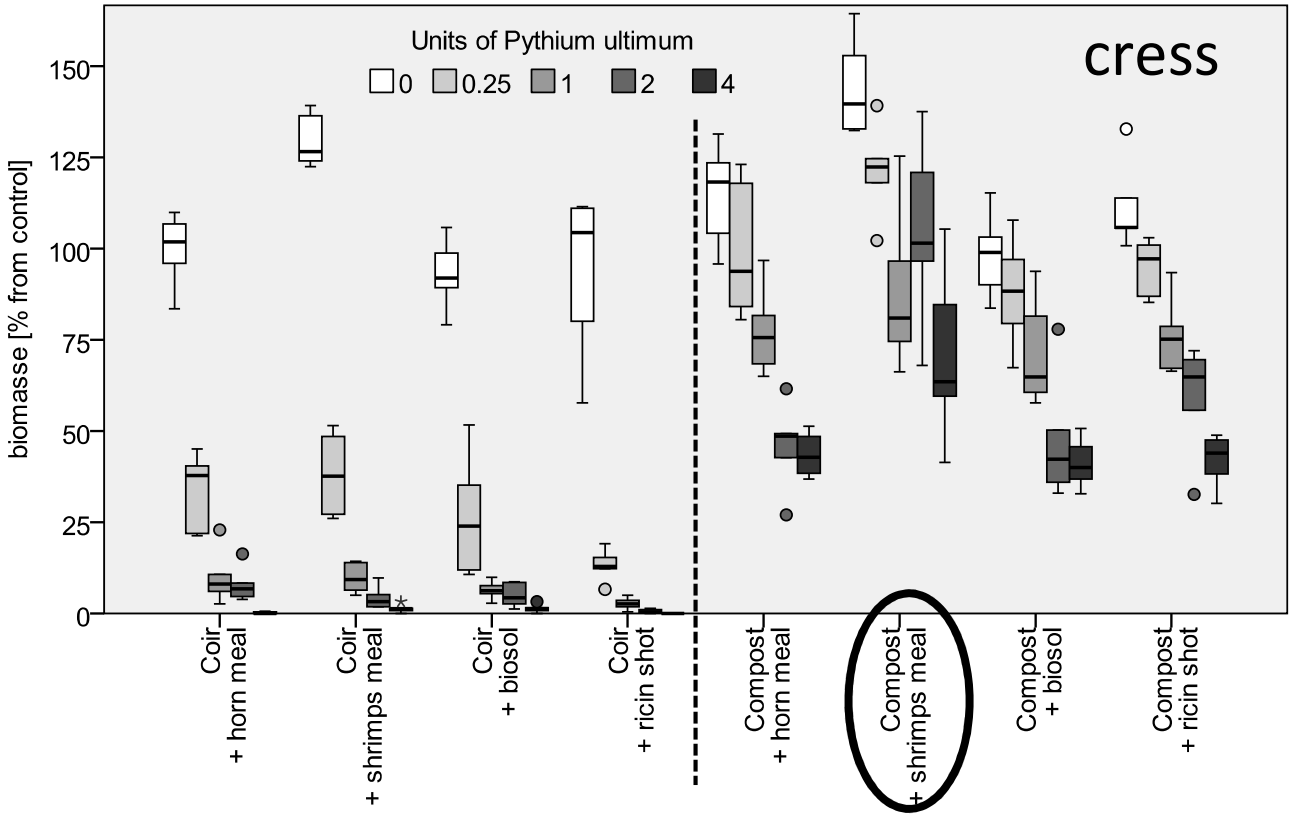
› ***Pythium ultimum* - cress (*Lepidium sativum*)**



Growing media: 70% “Einheitserde Typ 0” (Patzer GmbH) and 30% of coir or green waste compost

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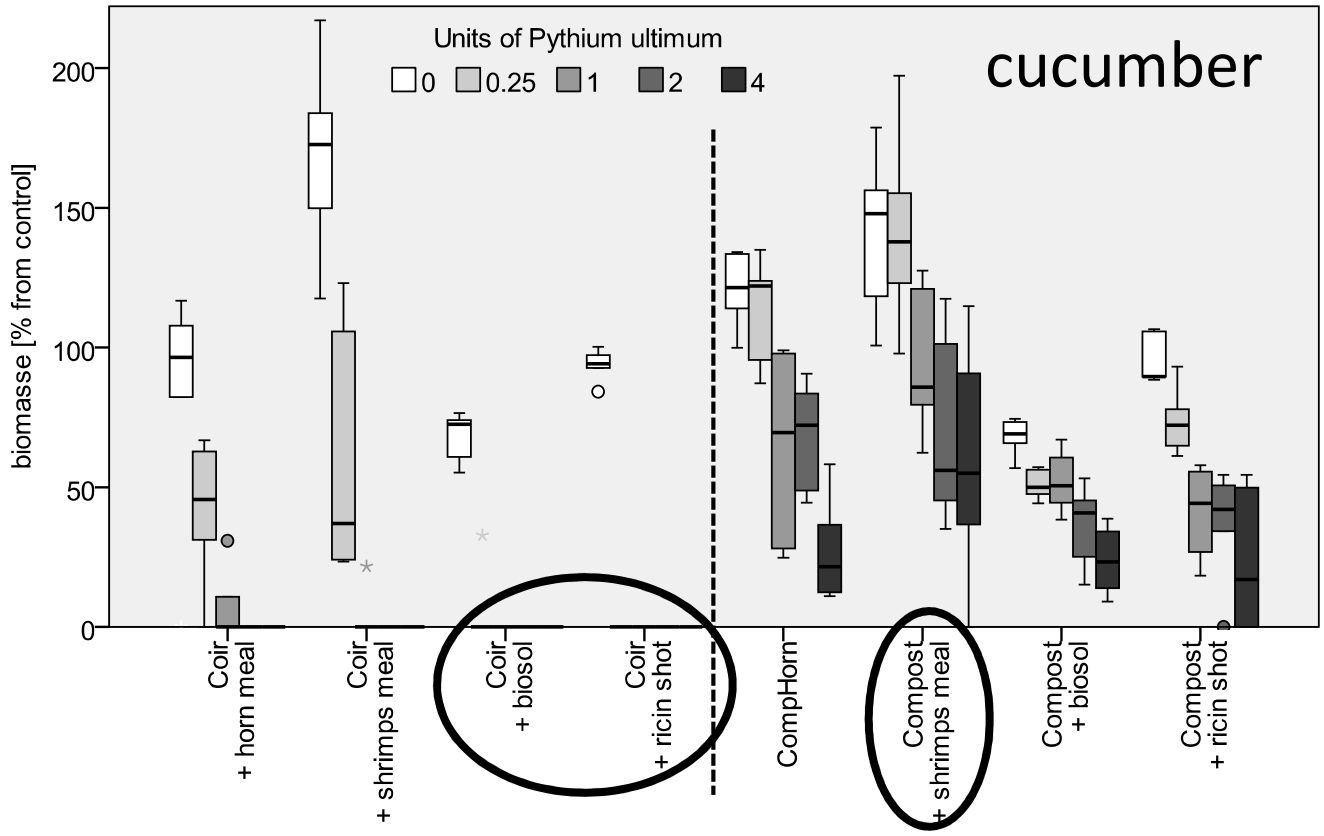

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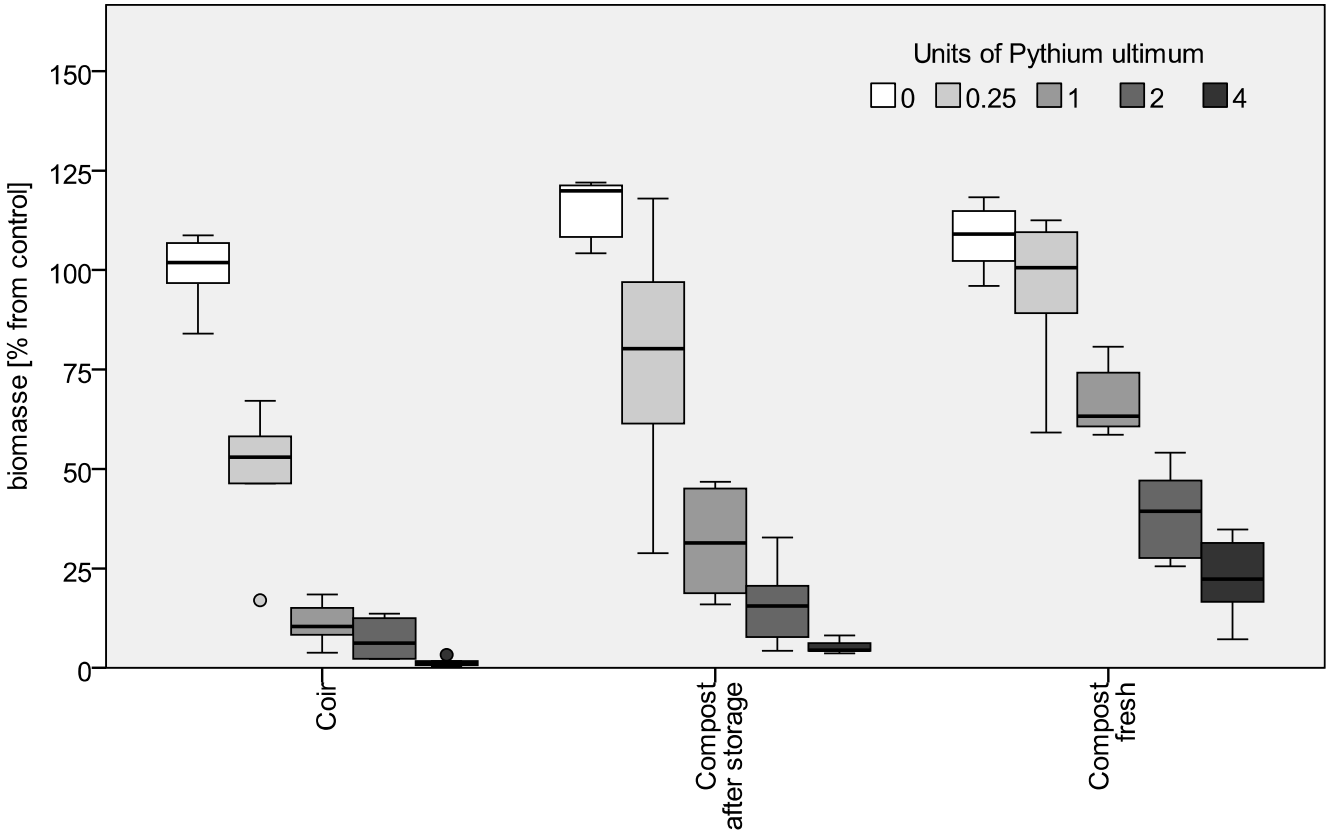

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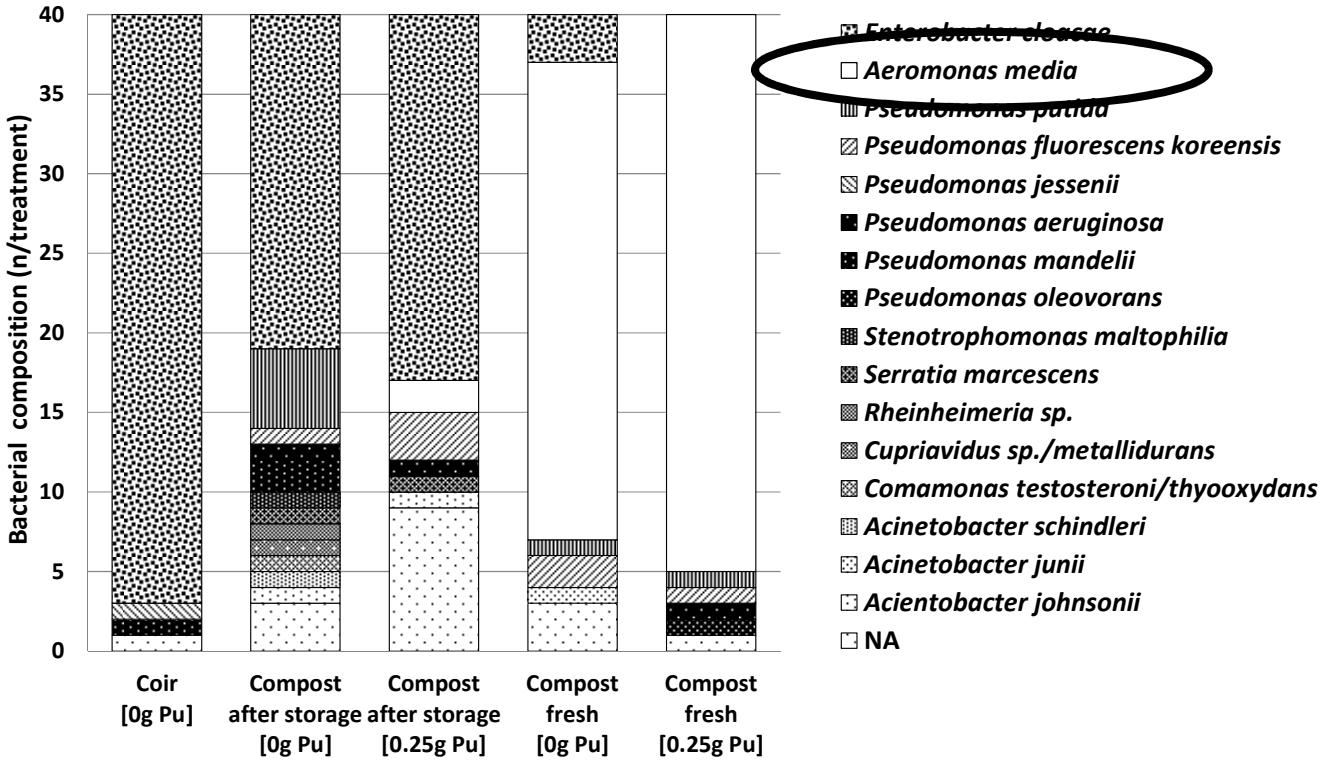

MS analysis of the most abundant rhizoplane bacterial isolates was performed with MALDI-TOF

Influence of fertilizers and peat substitutes on disease suppressiveness

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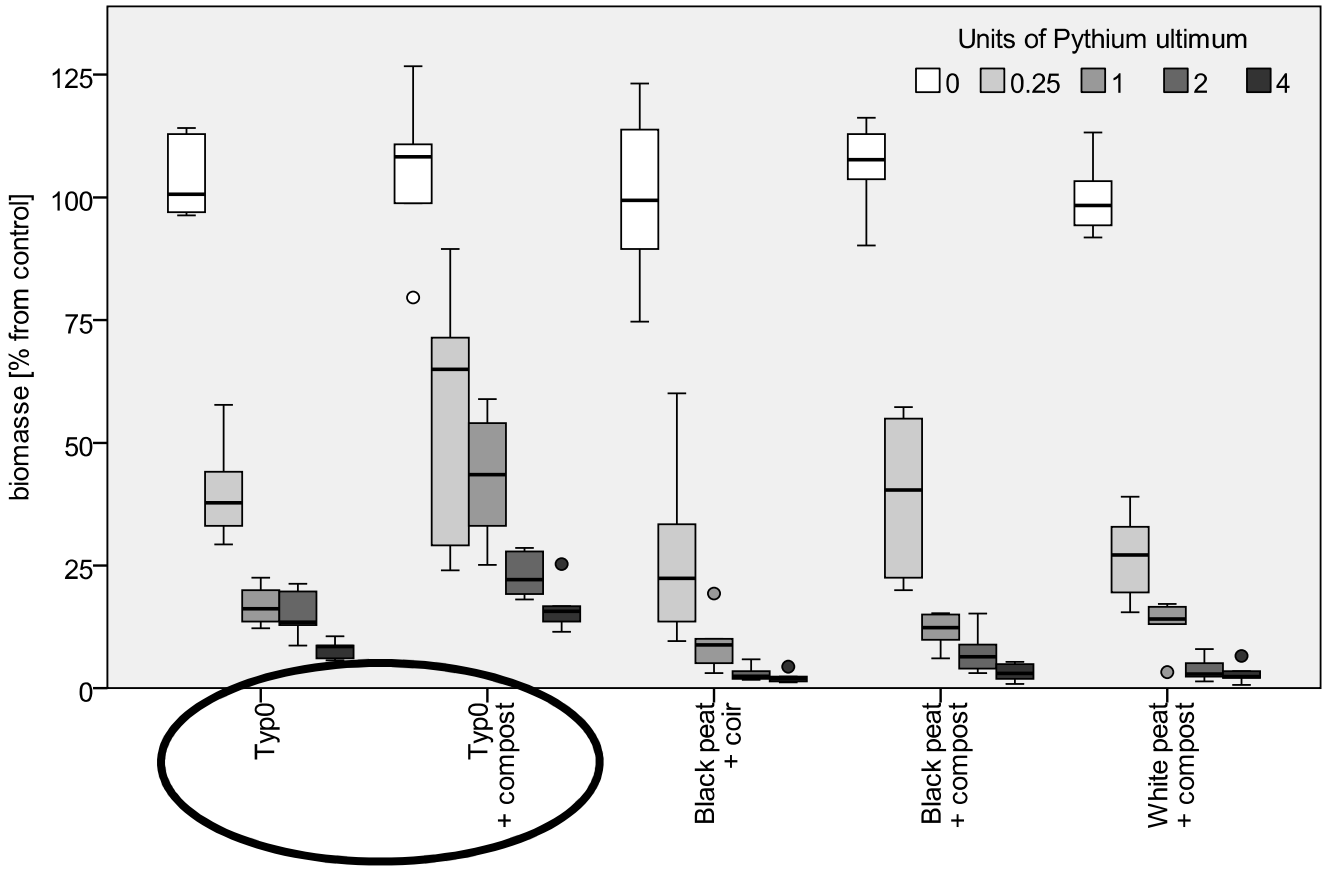
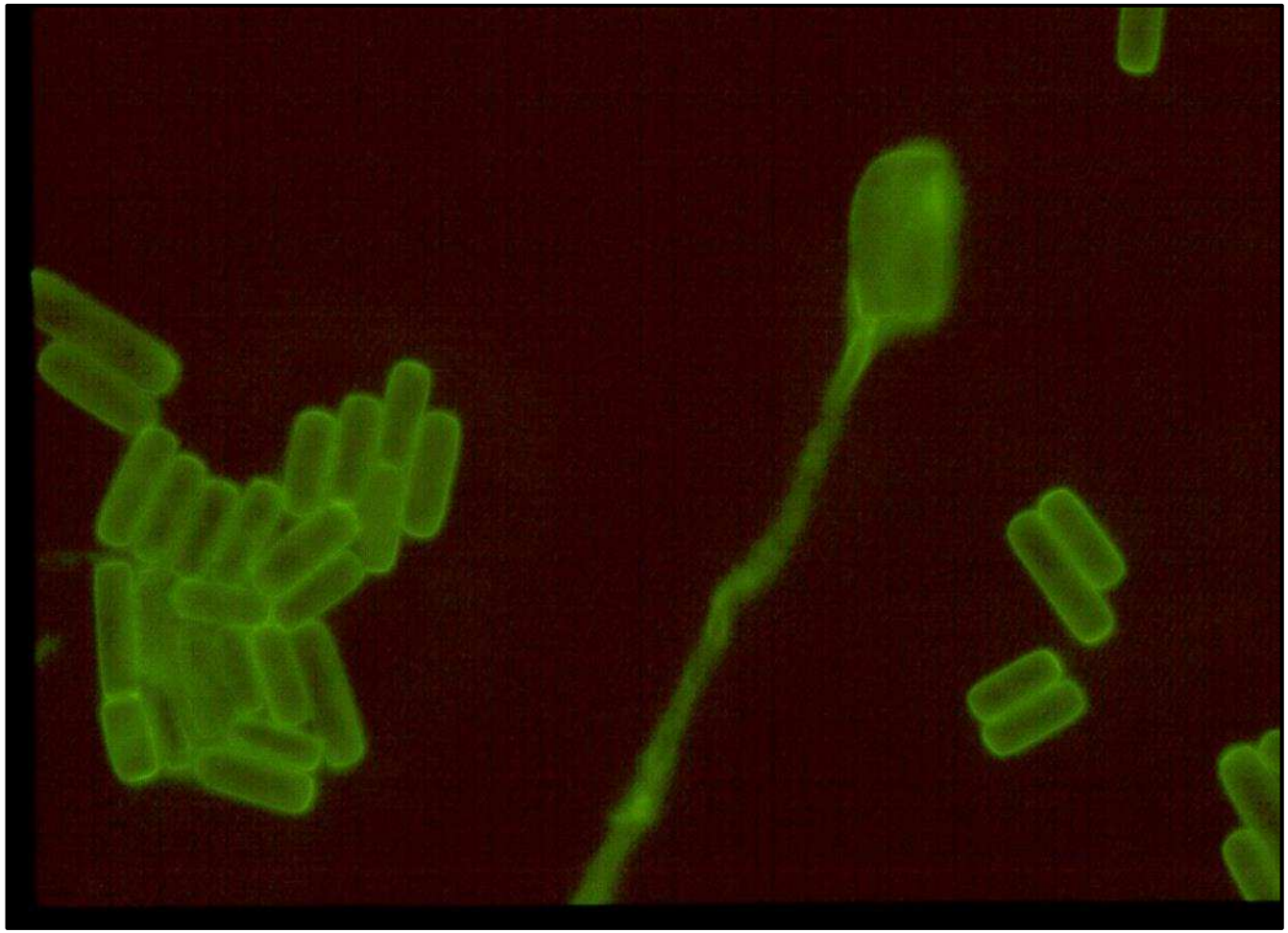


Growing media: 70% “Einheitserde Typ 0” (Patzer GmbH) and 30% of coir or green waste compost

Influence of fertilizers and peat substitutes on *Pythium* disease suppressiveness

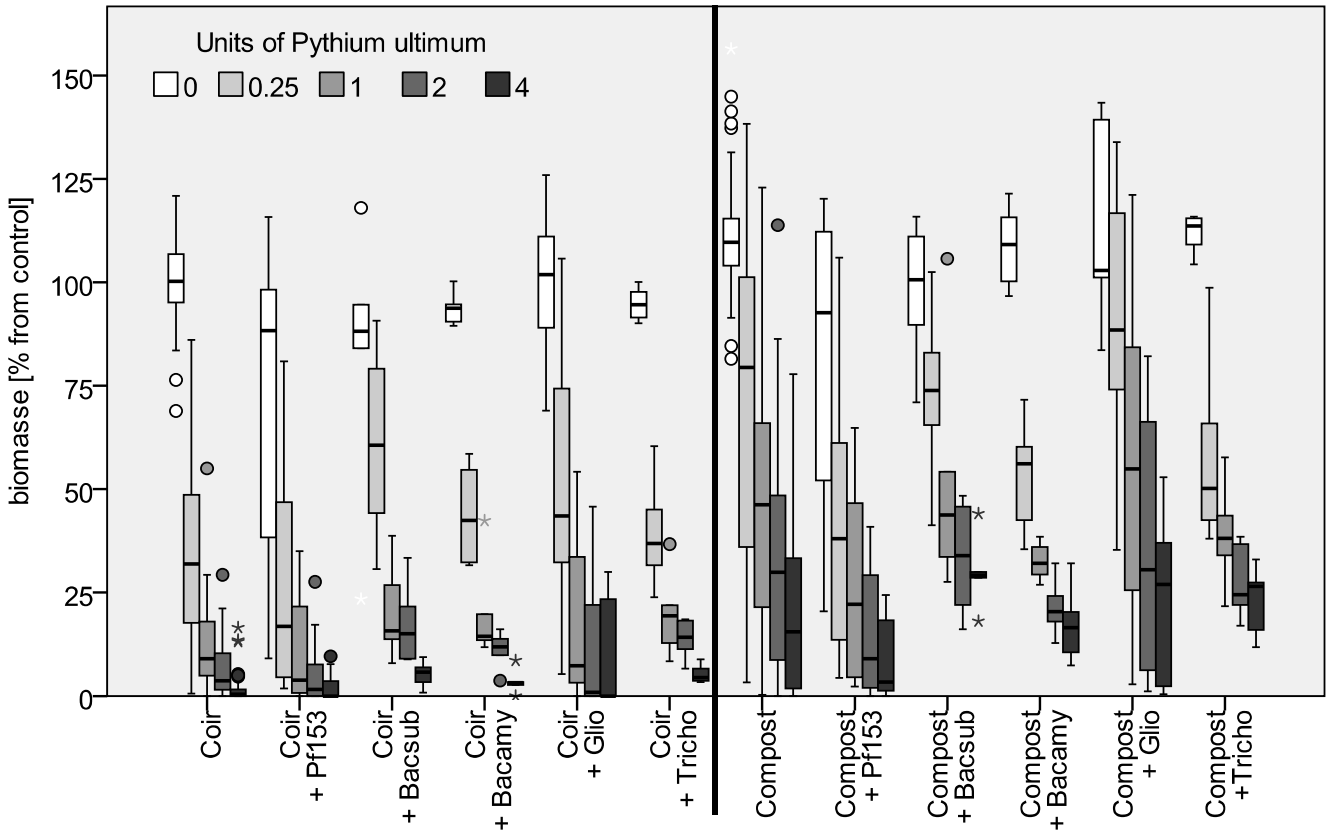
- **Tested organic fertilizers:**
  - cress: no influence the development of the disease, except shrimps meal in media with compost
  - cucumber: biosol and ricin shot increased the disease symptoms in the growing media with coir by cucumber
  - cucumber: shrimps meal reduce the disease intensity in the media with compost, but not in the media with coir
- **Compost:**
  - the compost tested reduce the disease intensity in comparison with coir
  - this effect was less evident after compost storage (under not optimal conditions)
  - the relative number of *Aeromonas media* was more abundant in *Pythium* suppressive media
  - addition of *Aeromonas media* into conducive growing media improved suppressiveness against *P. ultimum*
  - the basic component used in the growing mixture influenced also the capacity of compost to protect the plants against disease

Use of biocontrol agents to improve the disease suppressiveness



Use of biocontrol agents to improve the disease suppressiveness

› Commercial biocontrol agents

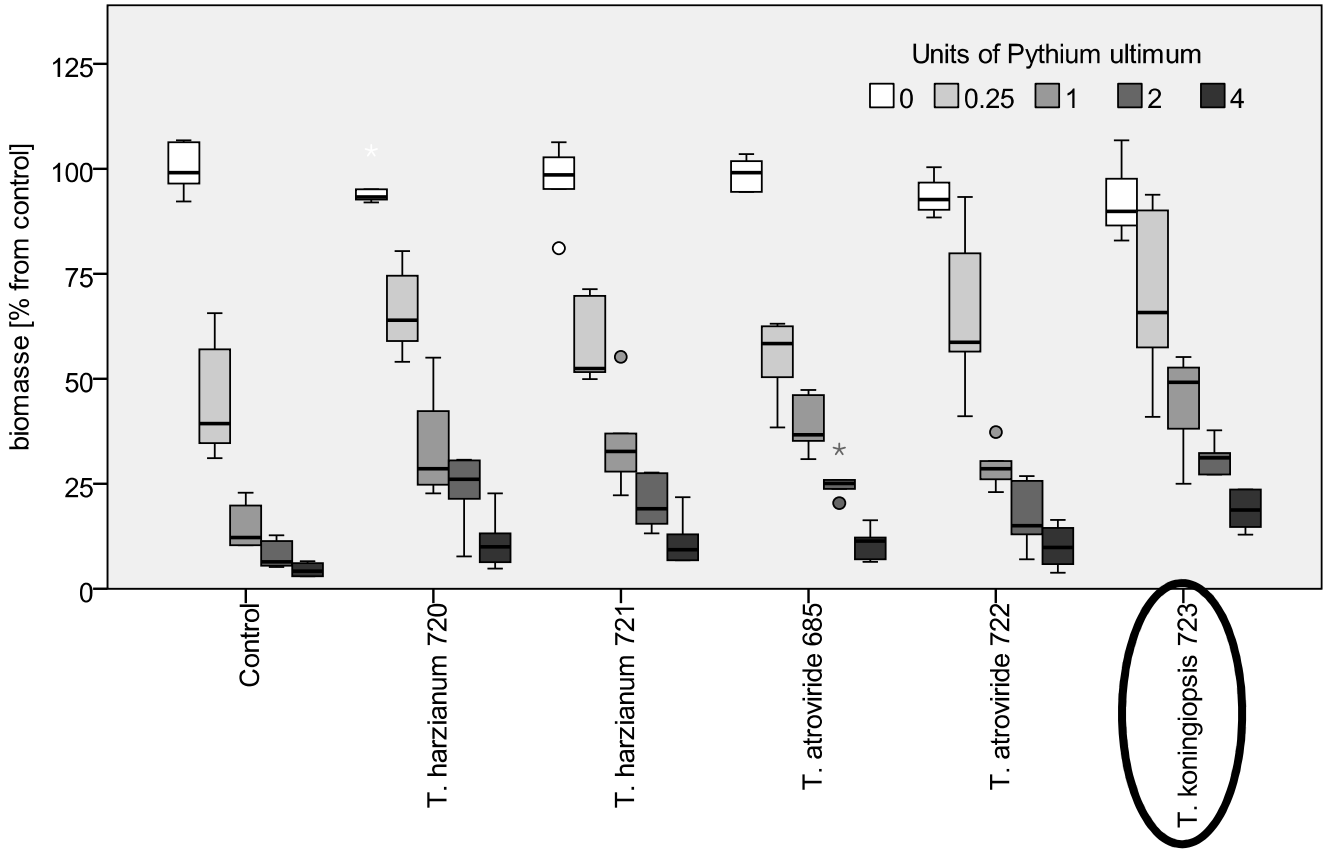


Growing media: 70% “Einheitserde Typ 0” (Patzer GmbH) and 30% of coir or green waste compost

Pf153: *Pseudomonas fluorescens* (Biofitac Pf1)
Bacsub: *Bacillus subtilis* (Serenade Max)
Bacamy: *B. amyloliquefaciens* (AmyloX)
Glio: *Gliocladium catenulatum* (Prestop)
Tricho: *Trichoderma harzianum* (Trianum)

Use of biocontrol agents to improve the disease suppressiveness

- **Test of new *Trichoderma* strains**
  - *Pythium ultimum* - cress (*Lepidium sativum*)



Growing media: 70% of limed black peat and 30% of coir

Use of biocontrol agents to improve the disease suppressiveness

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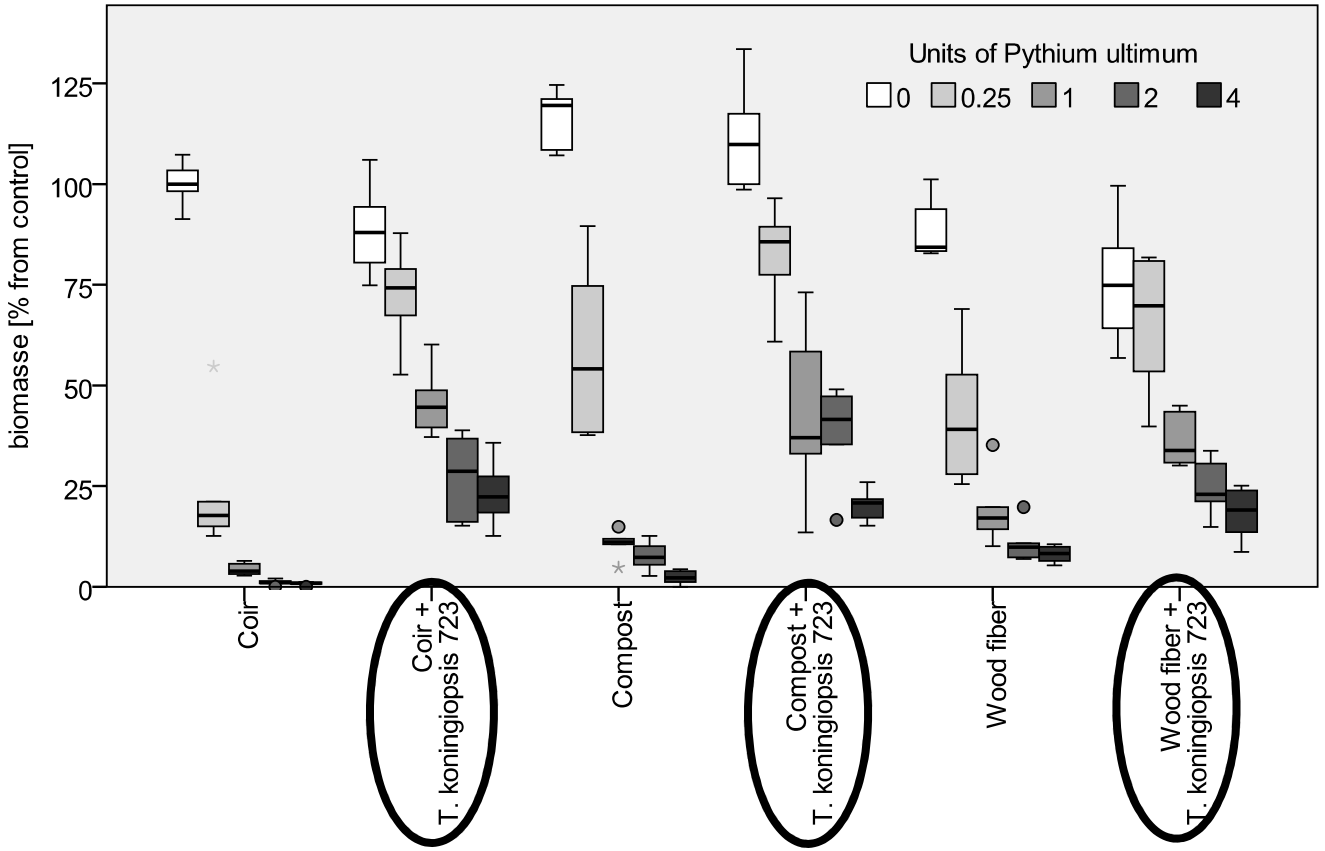
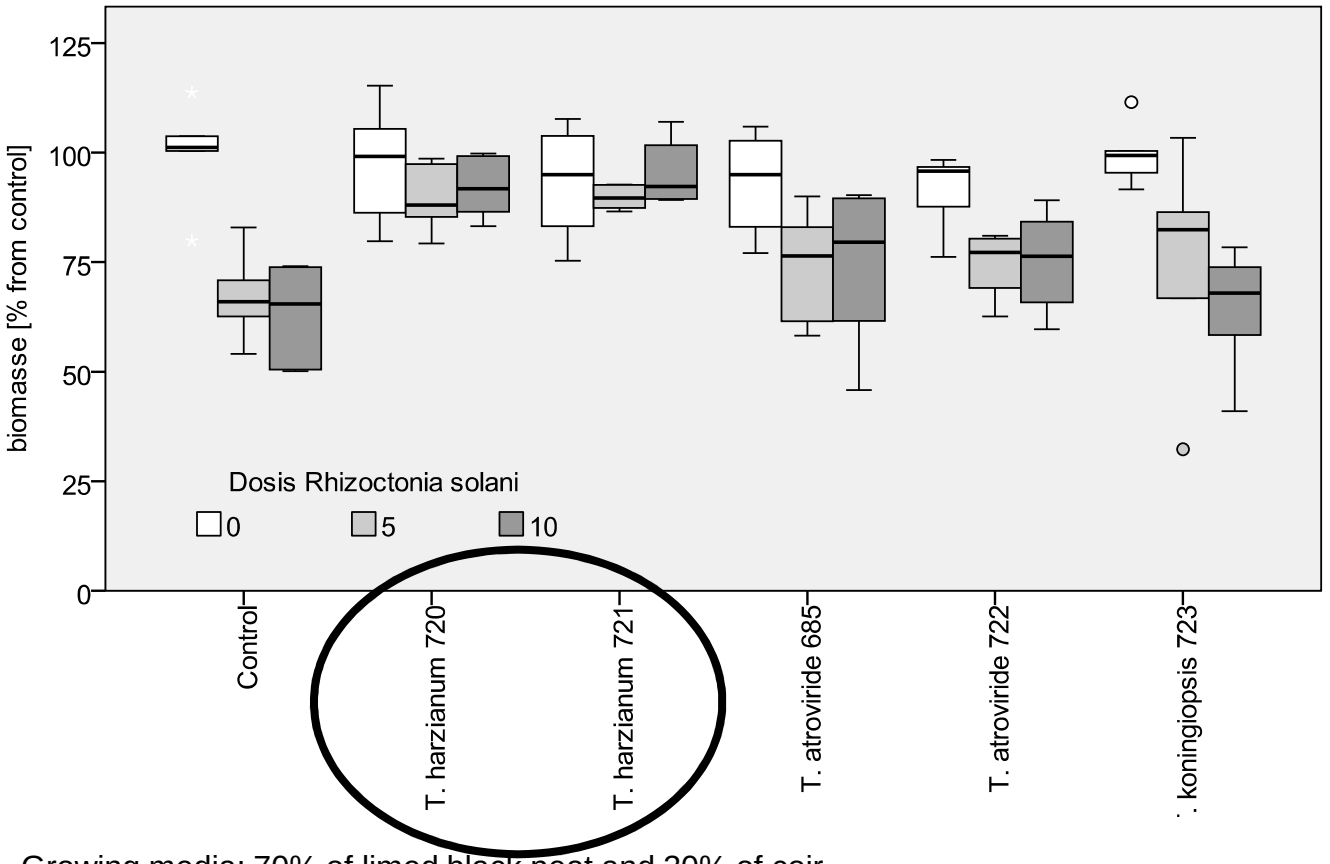


Growing media: 70% of limed black peat and 30% of coir, of green waste compost or of wood fiber

Use of biocontrol agents to improve the disease suppressiveness

- **Test of new *Trichoderma* strains**
  - *Rhizoctonia solani* - basil (*Ocimum basilicum*)



Growing media: 70% of limed black peat and 30% of coir

Use of biocontrol agents to improve the disease suppressiveness

- **Tested commercial biocontrol agents: no protection of the plants against diseases**
- **New strains of Trichoderma spp.**
  - some of them suppress disease in the tested growing media. Compost may enhance their effect in some cases (e.g. T 723 against Pythium on Cress)
  - the efficacy of the strains was disease specific
  - combination of several Trichoderma strains should be tested

Conclusions

Conclusions

- **The suppressive characteristics of growing media can be influenced by the composition of the basic compounds and the addition of biocontrol agents**
- **Organic fertilizers are less involved in plant protection than is compost**
- **Suppressive potential of compost varied depending of the compost itself, but also of the other components in the growing media (*Aeromonas* sp.: is it an indicator of the compost capacity to suppress diseases?)**
- **Application of effective strains of biocontrol agents might lead, in combination with compost, towards a good solution against pathogens**

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