Risk evaluation of biochars with indicator organisms

US Biochar Conference 2012
Sonoma

MSc. Daniela Busch
Soil Biogeochemistry
Martin – Luther – University
Halle Germany

Overview

- Introduction
- Risk evaluation with adult plants
- Assessments on impacts on soil microorganisms
  - The luminescent bacteria test
- Assessments on impacts on soil organisms from higher ranks
  - The earthworm avoidance test

Introduction

- Biochar for soil amendment includes the possibility for environmental risks
  - PAH´s PCDD & PCDF´s and further contents
  - Xenobioticas can be formed during industrial biochar and hydrochar production (but not always)
- Once in the soil, pollutants may not removeable
- Short and safe bioassays are a cost efficient way for biochar and hydrochar assessment

Introduction

- Biochar´s material properties and toxic potentials vary with its production parameters and feedstocks
- Esp. in Germany occurs a great variety of biochars (and hydrochars)

Comparison of biochar and hydrochar

Biochar

- From slow or fast pyrolysis
- Dry and very light in its properties
- pH values around 8 to 10

Hydrochar

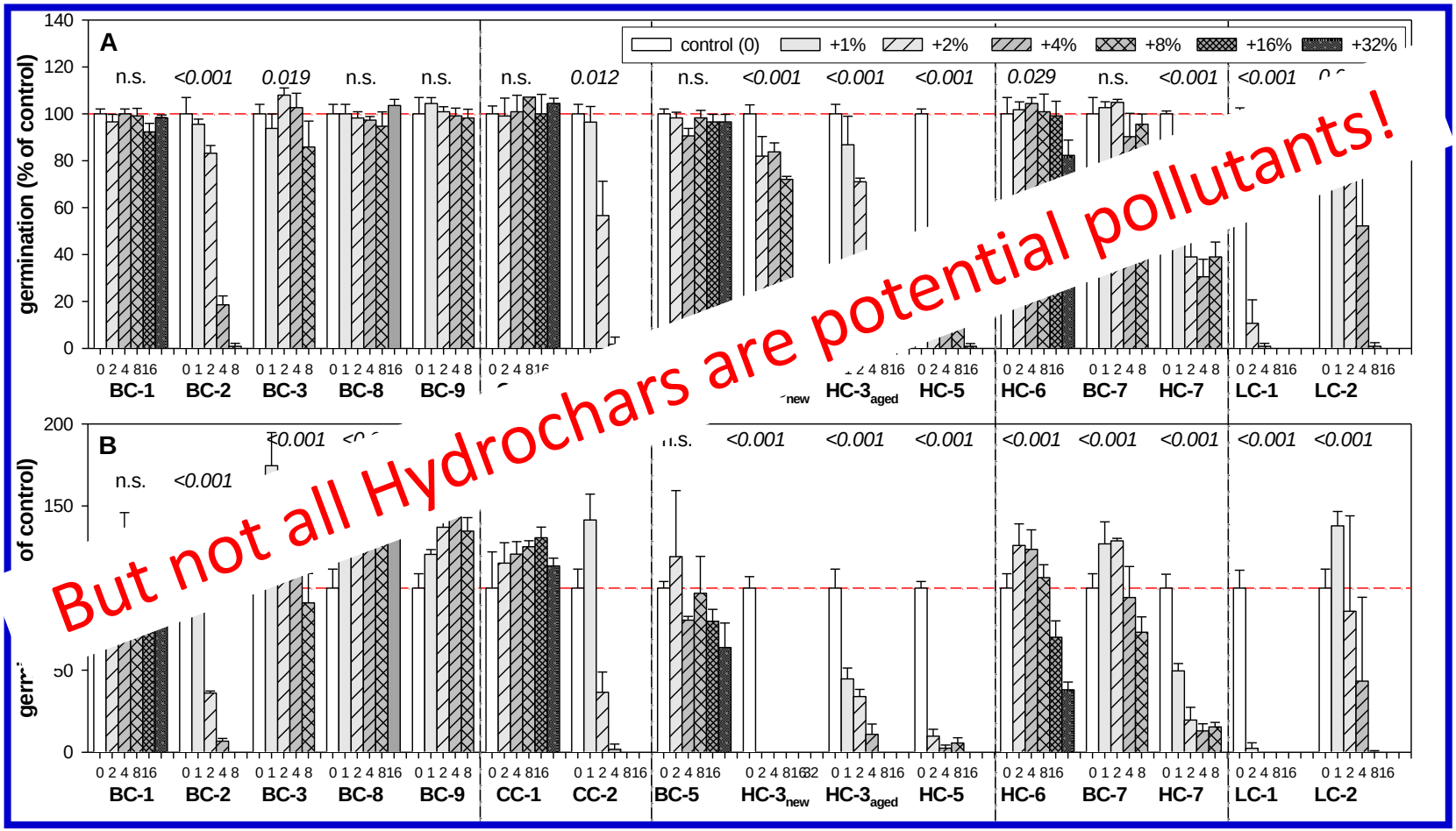
- From hydrothermal carbonization
- Wet to liquid
- pH values from 3.5 to 4.5

Pictures: D. Busch 2012

What is Hydrochar?

- HC / OC ratios like brown coal
- Relatively low pH values
- In Germany well discussed as alternative method for carbon sequestration and soil amendment
- But: there were some problematic properties observed!
- It sometimes contains unknown toxic compounds

Examples from phytotoxicity tests with salad seeds:



Kammann et al. 2012

Risk evaluation with adult plants

- Beside risk assessments with germination and growth tests
- Effects on adult plants with determined root systems
- Plant species *Tradescantia* allows genotoxic and phytotoxic assessments (plant habitus and health)

Risk evaluation with adult plants

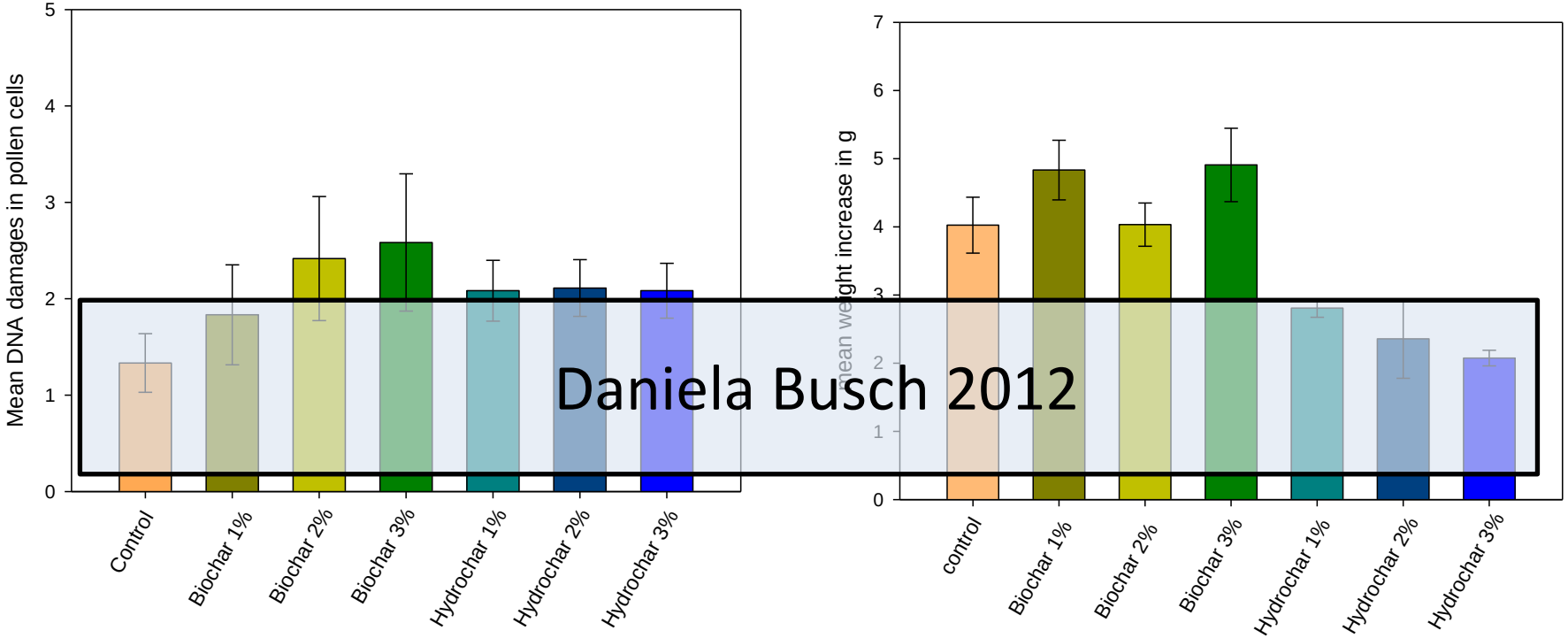
Biochar

- 1, 2 and 3 % v/v
- comparison to hydrochar
- Biochar from gasification (~ 1000° C)

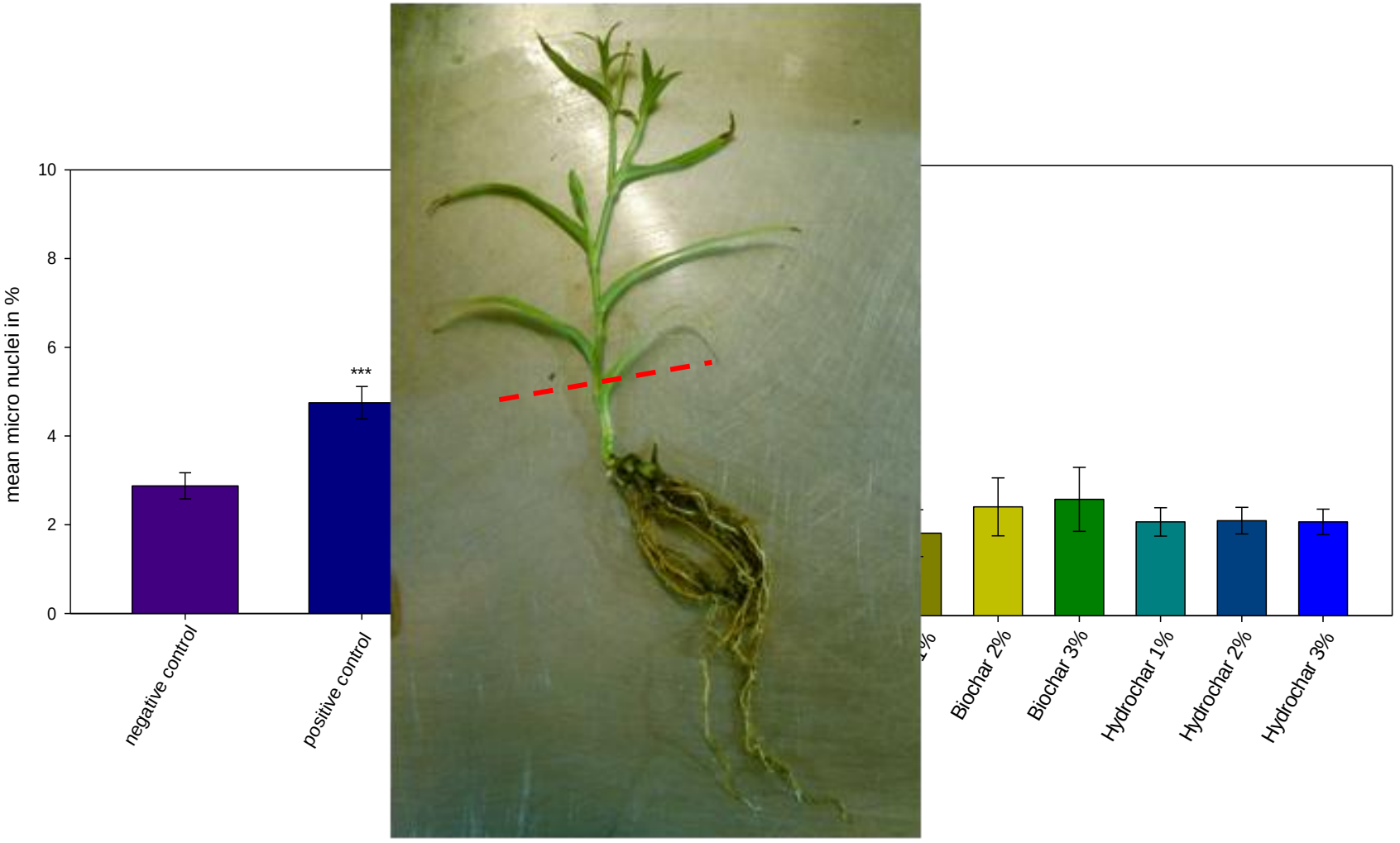
Hydrochar

- 1, 2 and 3 % v/v
- Pre-tests with higher concentrations had lethal effects (plants died since 6 days)
- Dried hydrochar (granulate)

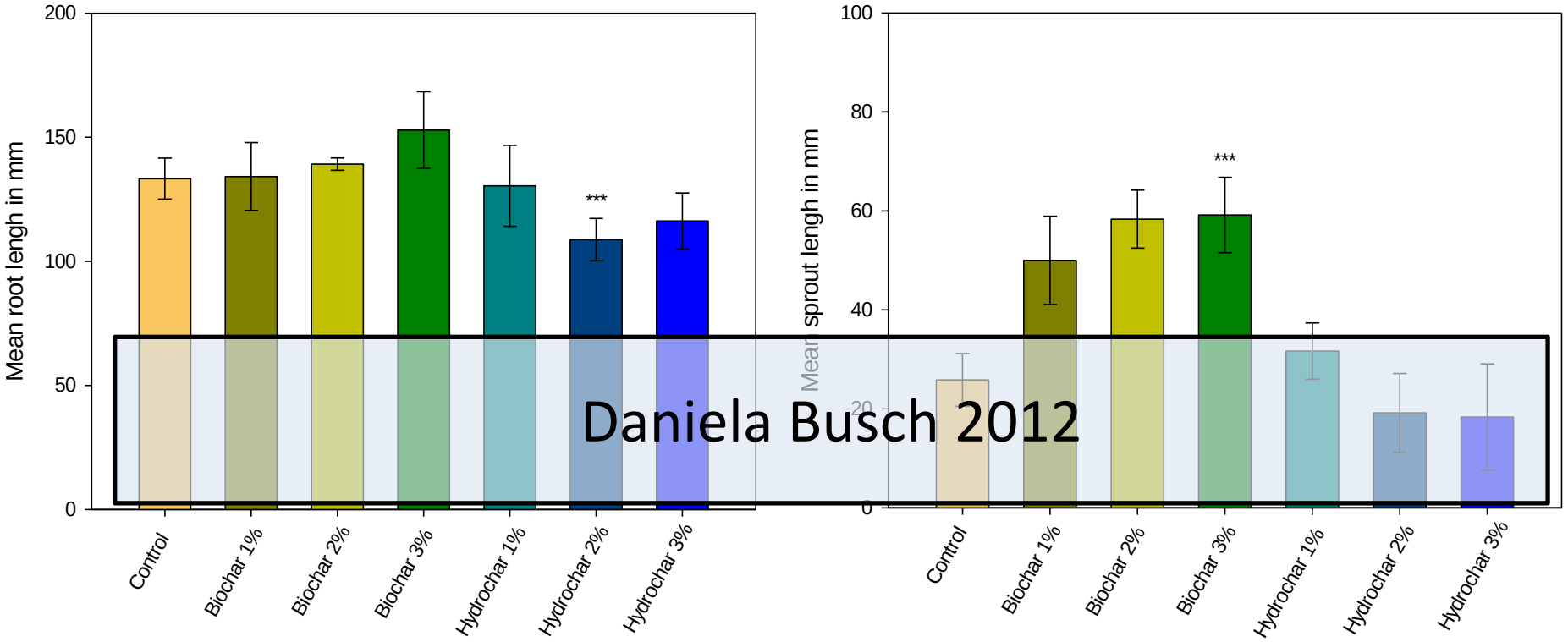
Risk evaluation with adult plants after growth period of 51 days



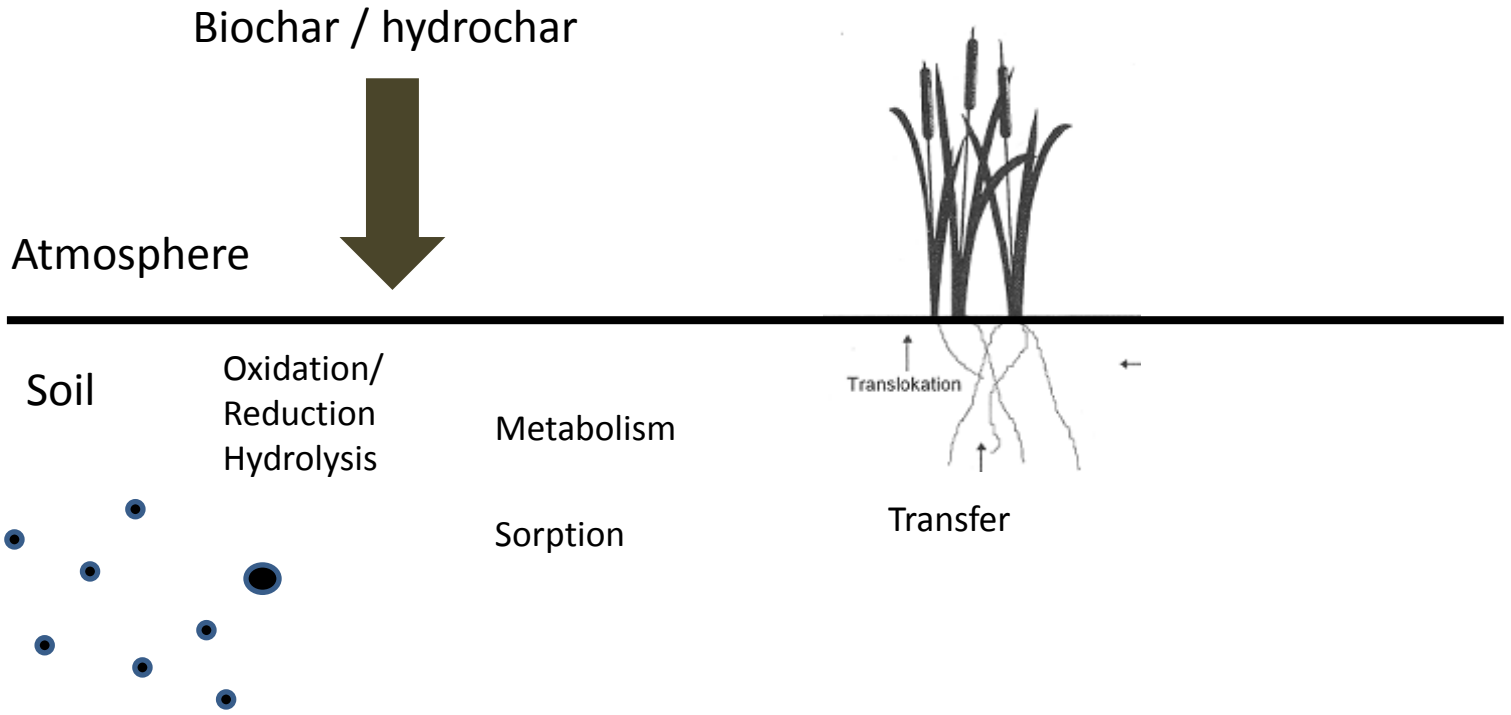
For comparison: the conventional *Tradescantia* test with the liquid phase of hydrochar



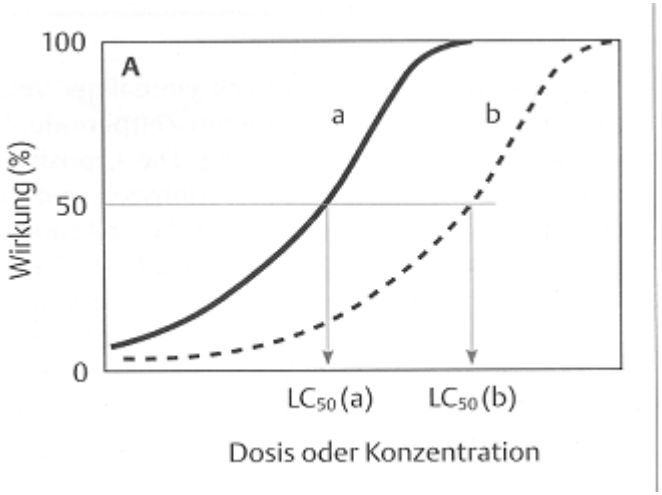
Risk evaluation with adult plants after growth period of 51 days



Assessments on impacts on soil microorganisms
The luminescent bacteria test



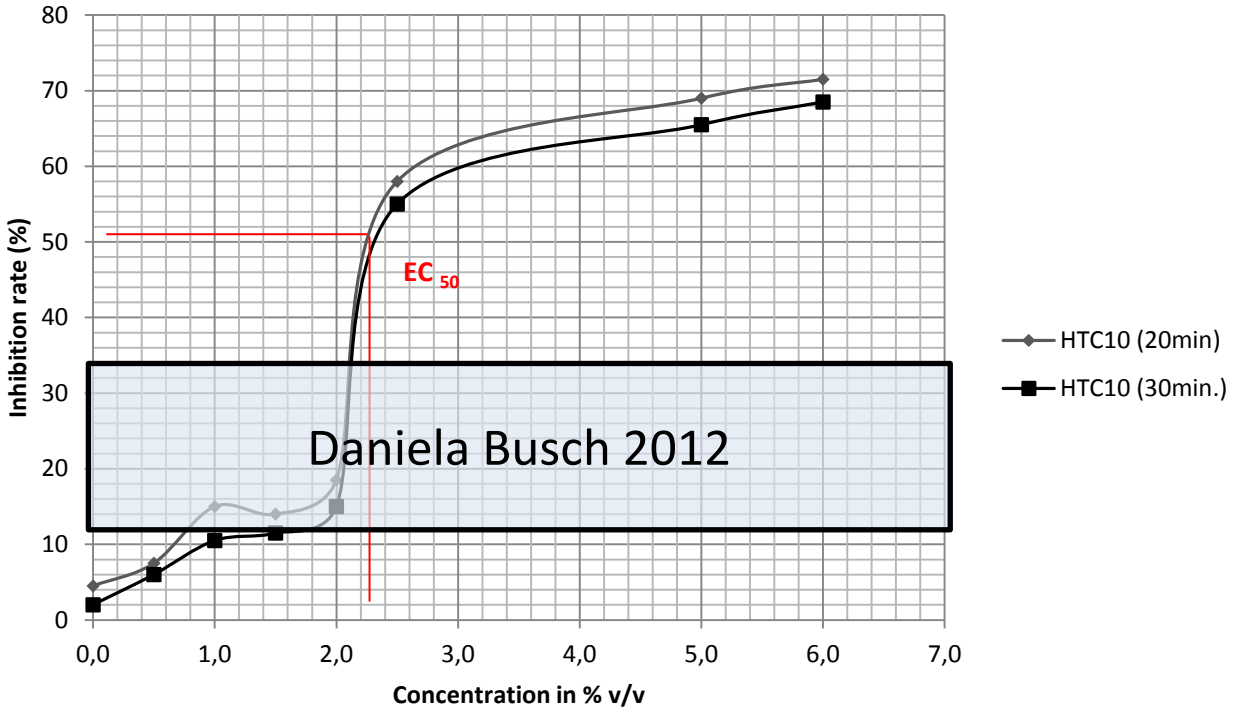
Assessments on impacts on soil microorganisms
The luminescent bacteria test



Using of bioluminescent bacteria

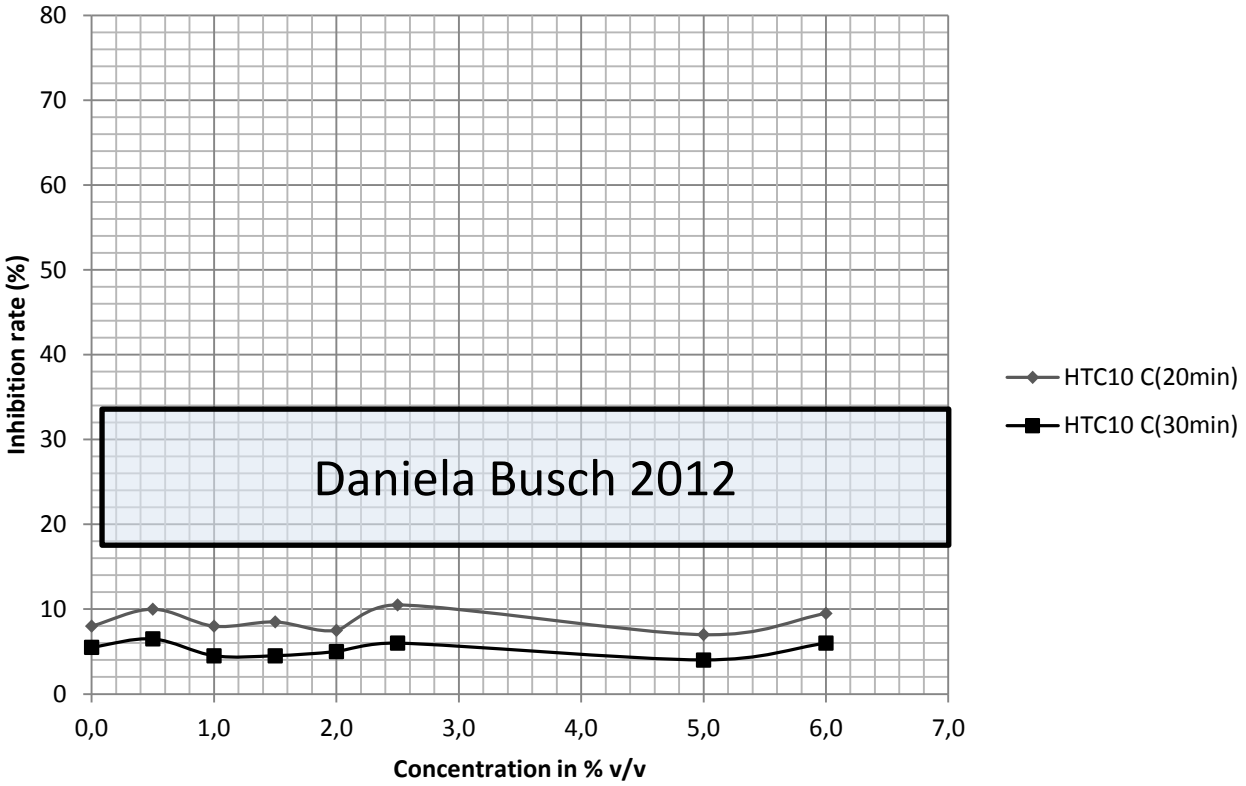
- Luciferasis is coupled on essential metabolic activities
- measuring of luminescence allows estimations of toxic effects of contaminants on bacteria

Assessments on impacts on soil microorganisms
The luminescent bacteria test



Hydrochar from maize silage in different application amounts

Assessments on impacts on soil microorganisms
The luminescent bacteria test



The same Hydrochar after composting

Conclusions

- Only positive growth effects with biochar
- Lethal effects of hydrochar after addition rate of 4 %v/v after 6 days
- EC of 50% after 2.3 % v/v in metabolic activities in V. fischeri
- Pollutants in hydrochar are biological degradable
- → see results on the poster

Thank you for attention!

Every big journey begins with the first step, we are on the way…

Further informations and results can be discussed:
Daniela.busch@landw.uni-halle.de