

# Risk evaluation of biochars with indicator organisms

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Sonoma

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# 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
  - Xenobiotics can be formed during industrial biochar and hydrochar production (but not always)
- Once in the soil, pollutants may not be removable
- 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

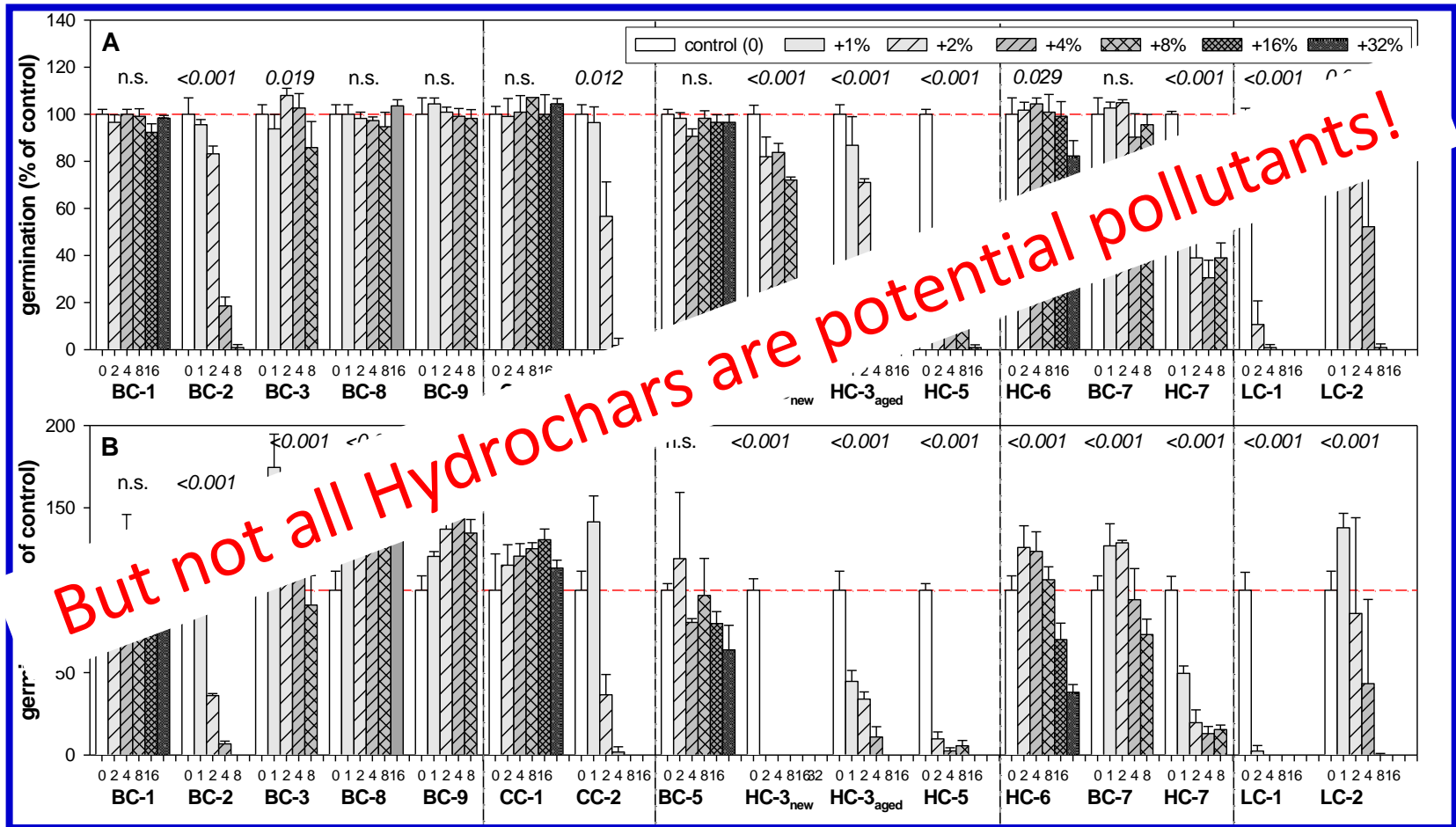


Pictures: D. Busch 2012

# 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:



# 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

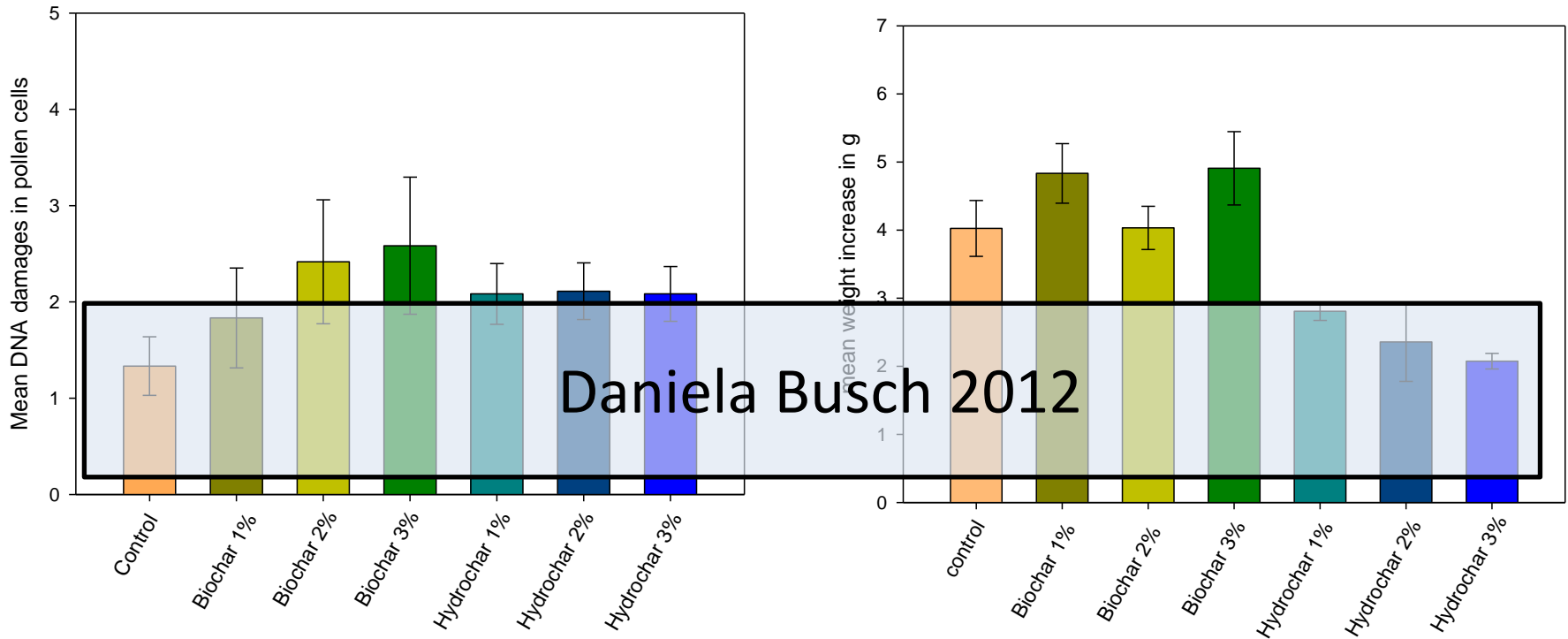
## Biochar

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

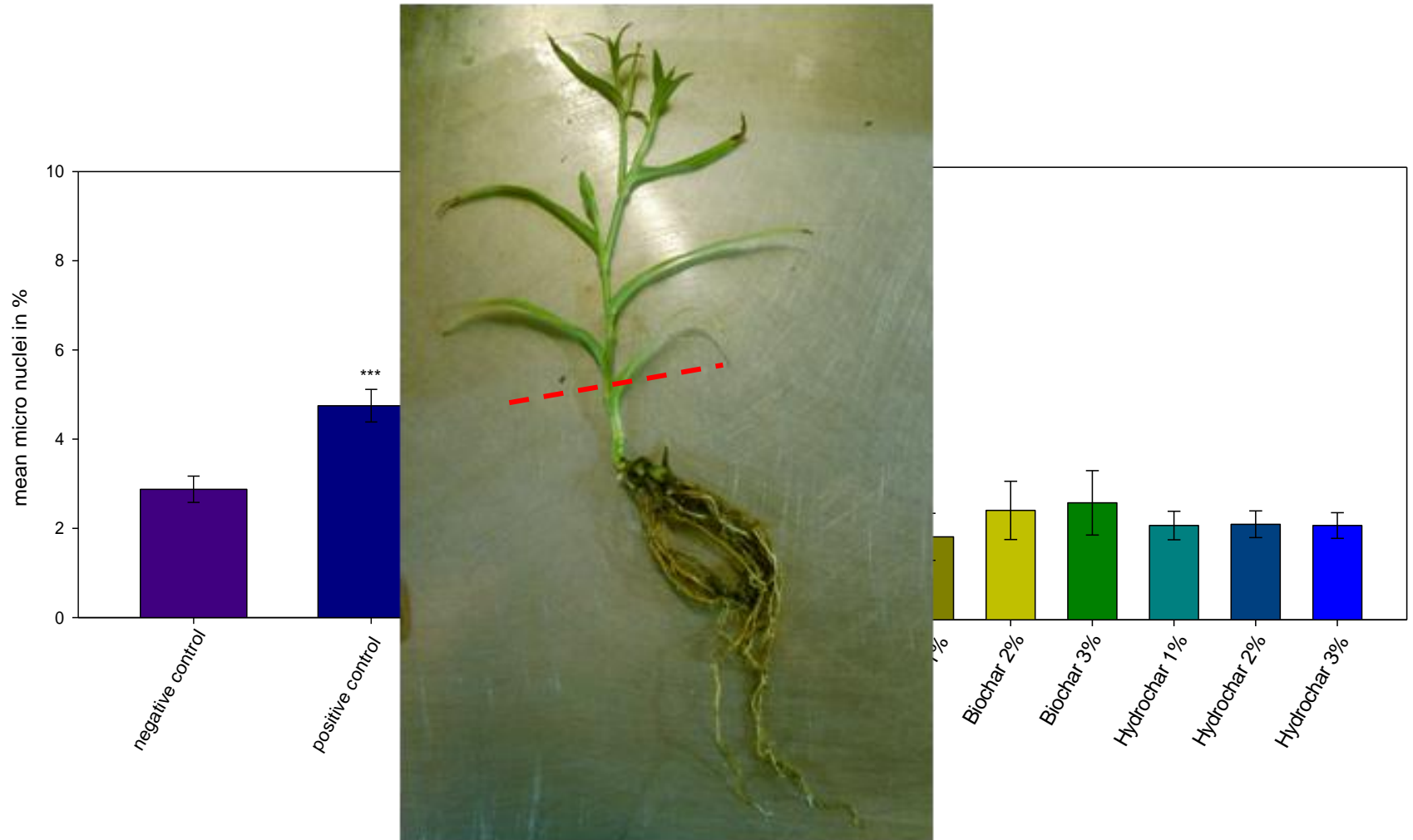
## Hydrochar

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

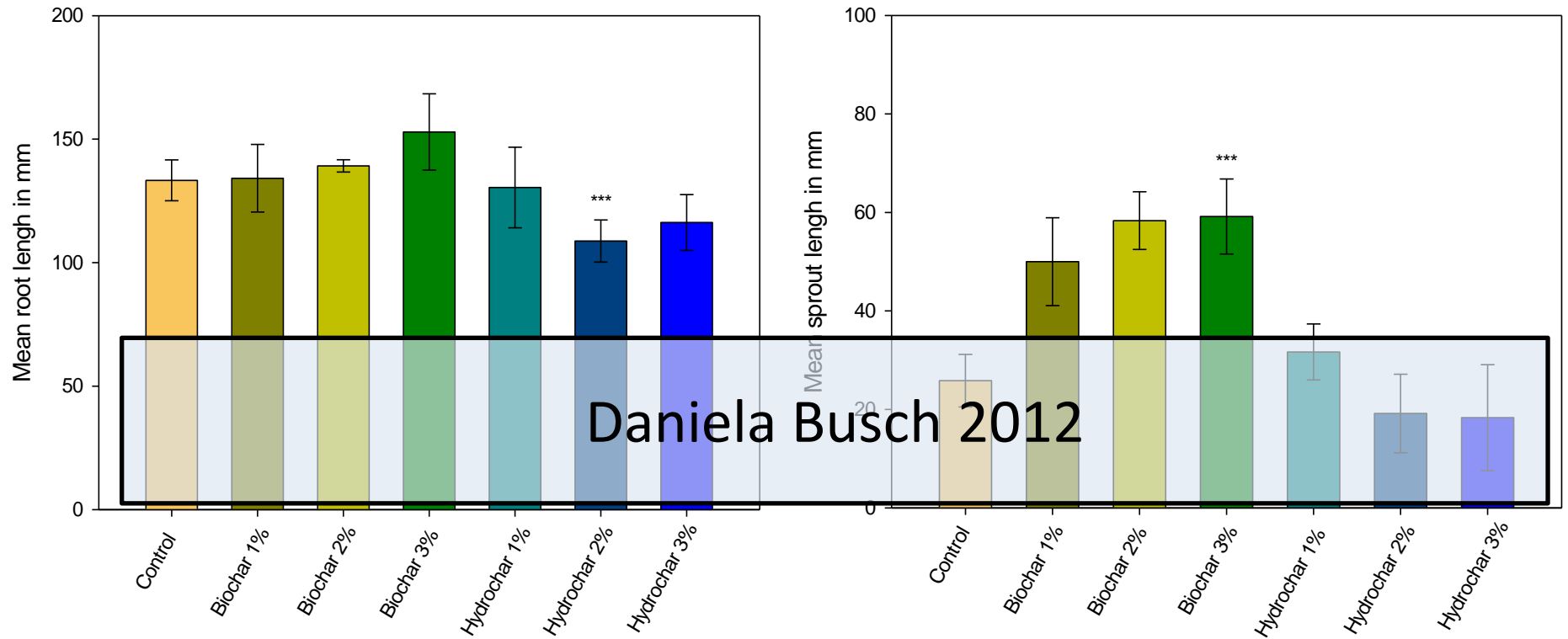
# Risk evaluation with adult plants after growth period of 51 days



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

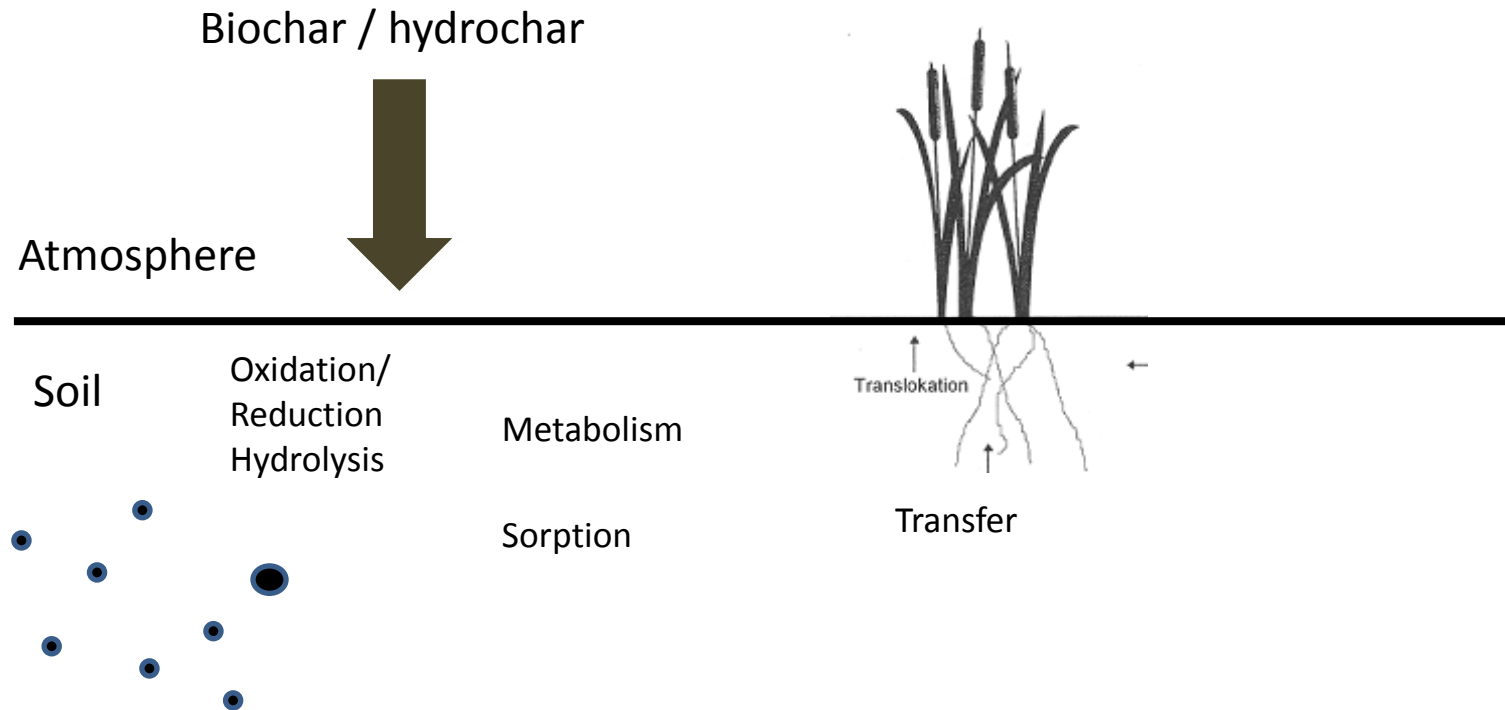


# Risk evaluation with adult plants after growth period of 51 days



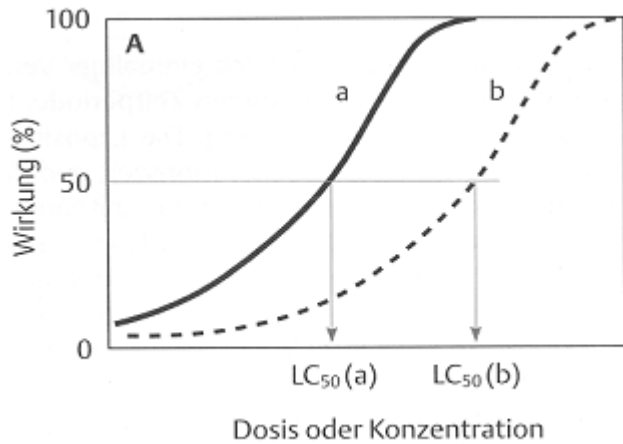
# Assessments on impacts on soil microorganisms

## The luminescent bacteria test



# Assessments on impacts on soil microorganisms

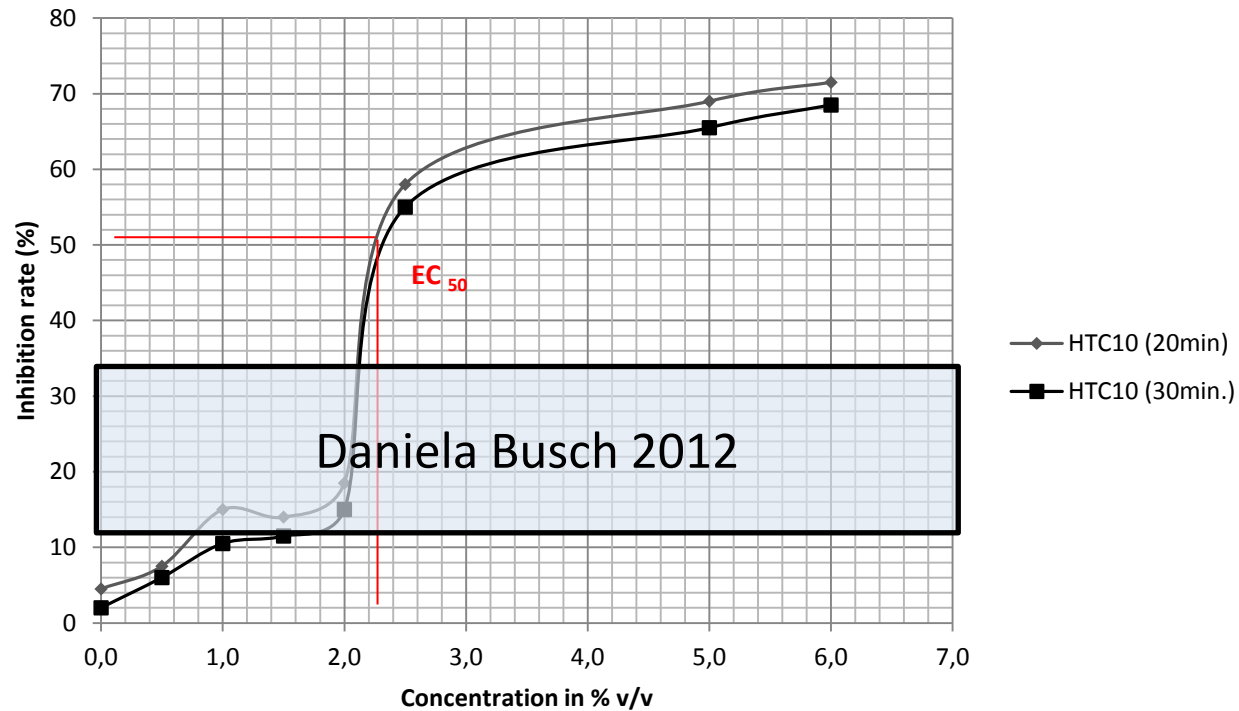
## The luminescent bacteria test



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

# Assessments on impacts on soil microorganisms

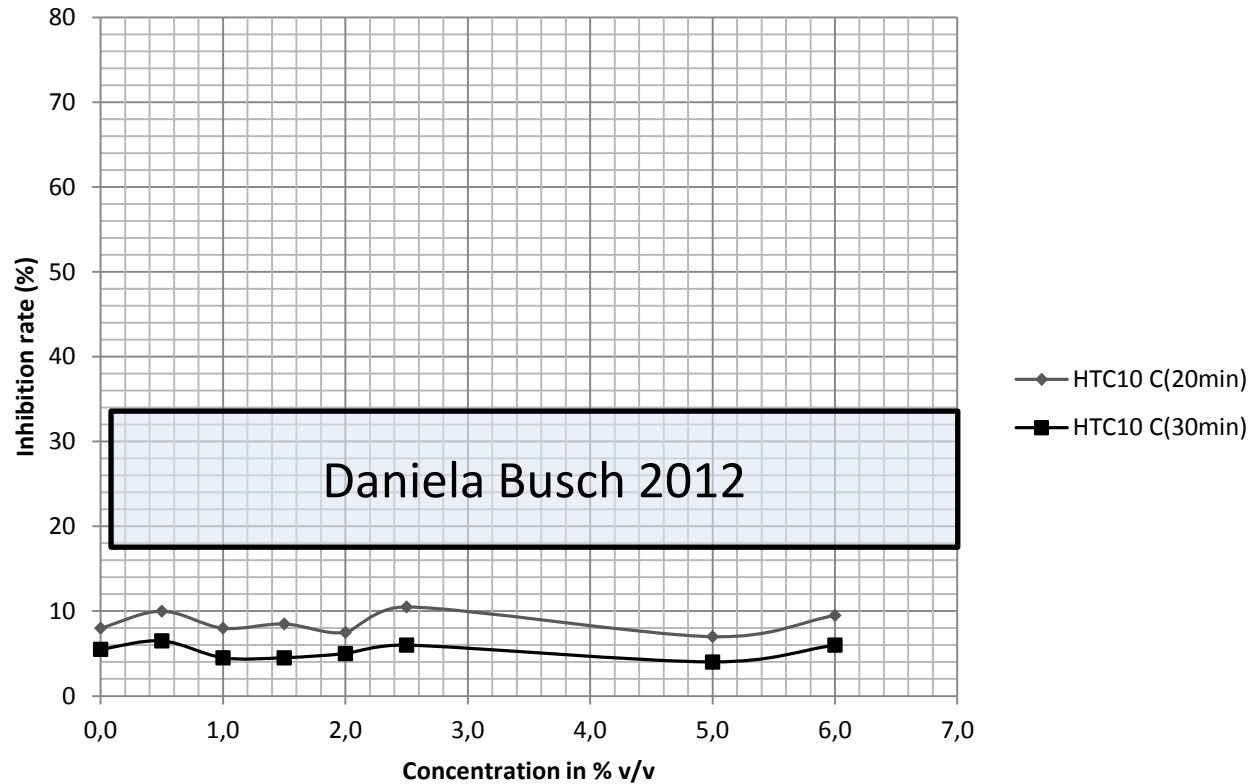
## The luminescent bacteria test



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:  
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## Environmental risk evaluation of hydrochars and biochars:



Phytotoxic compounds of some HTC materials can be biologically degraded

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