Hochschule Zittau/Görlitz
UNIVERSITY OF APPLIED SCIENCES

ZIRKON

„Influence of cultivation conditions on hemp roots"

Workshop „Industrial hemp – From cultivation to application"
8th May 2025
Lena Wehnert

Kofinanziert von der Europäischen Union

Freistaat Sachsen

Diese Maßnahme wird mitfinanziert durch Steuermittel auf der Grundlage des vom Sächsischen Landtag beschlossenen Haushaltes.

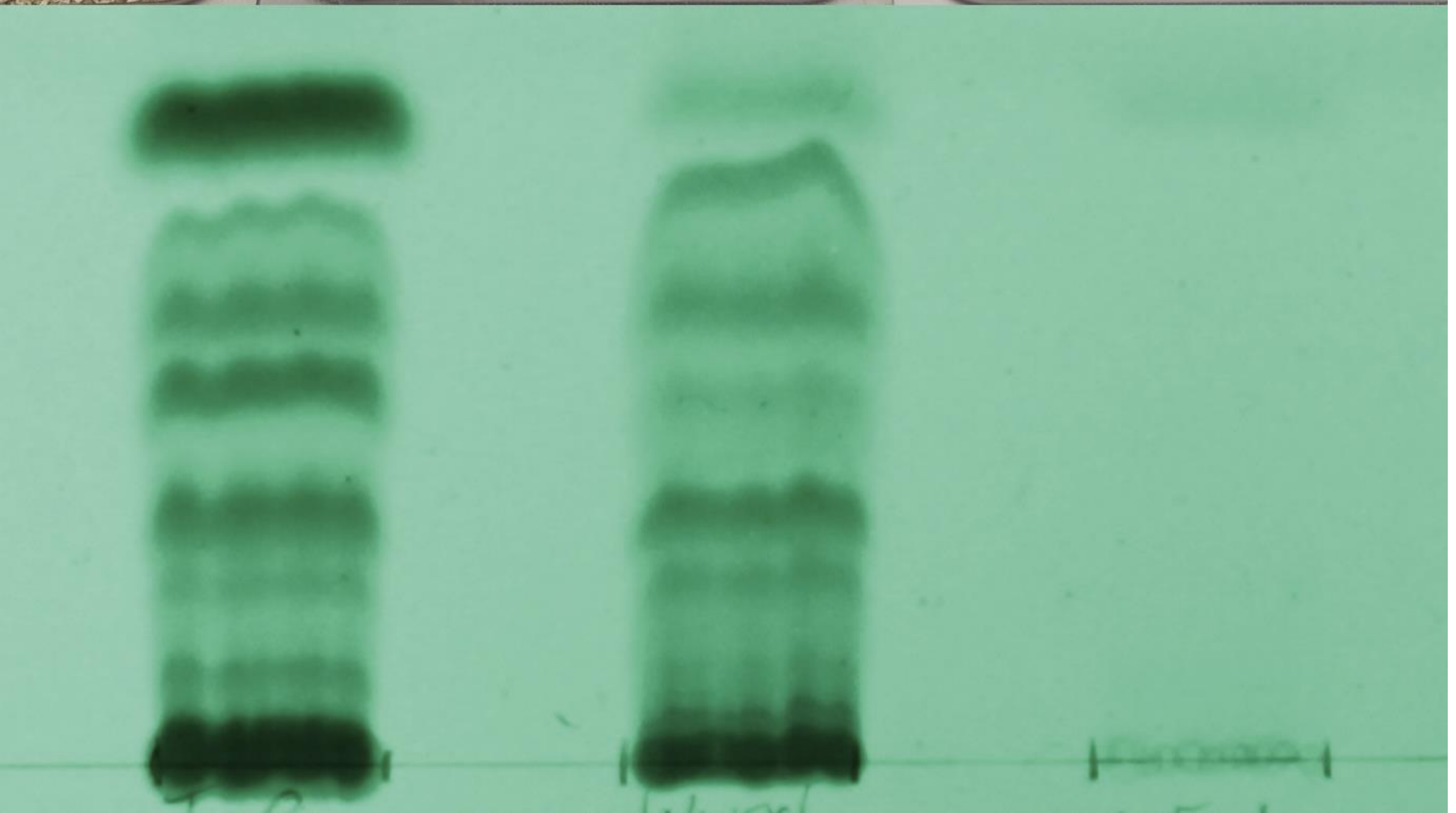


Table of contents

Hochschule Zittau/Görlitz
UNIVERSITY OF APPLIED SCIENCES

ZIRKON

Background

- Hemp (*Cannabis sativa* L.) has been cultivated as a crop for several hundred years
  - Use of the fibers for the textile industry or as an insulating material, seeds as food or edible oil
- Hemp roots have been documented and used as a traditional medicine for several centuries
  - Historically described use of hemp root as a medicine for gout, arthritis, fever and other infectious diseases (Ryz et al. 2017)
- Investigation of the influence of cultivation conditions, processing and extraction methods on the spectrum of bioactive compounds in hemp roots

Cultivation conditions

Possible influencing factors:

- Cultivation location (Zittau, Mücheln (Geiseltal) → Cooperation with Hanffaser Geiseltal)
- Weather conditions
- Nutrient availability
- Soil composition
- Variety of industrial hemp (e.g. *Cannabis sativa* L. “Fedora 17”, “Futura 75”, “Felina 32”)

Planned experiments

1) Roots

Harvested and washed hemp roots.

- Manual harvesting of the roots
- 2 samples per year at the two cultivation sites

Parameters to be determined:

- Shoot and root length
- Wet and dry weight (shoot, root) → Water content
- Morphology (photographic documentation)
- Shoot to root ratio (length, water content)

Planned experiments

1) Roots

2) **Soil composition**

Hemp field in Zittau.

- Yearly analysis of the soil composition at the cultivation sites

Parameters to be analyzed:

- Soil type
- Hummus content
- Water content
- Conductivity, pH-value
- Nutrient content (nitrate, ammonium, phosphate)
- Cation exchange capacity
- Element concentrations

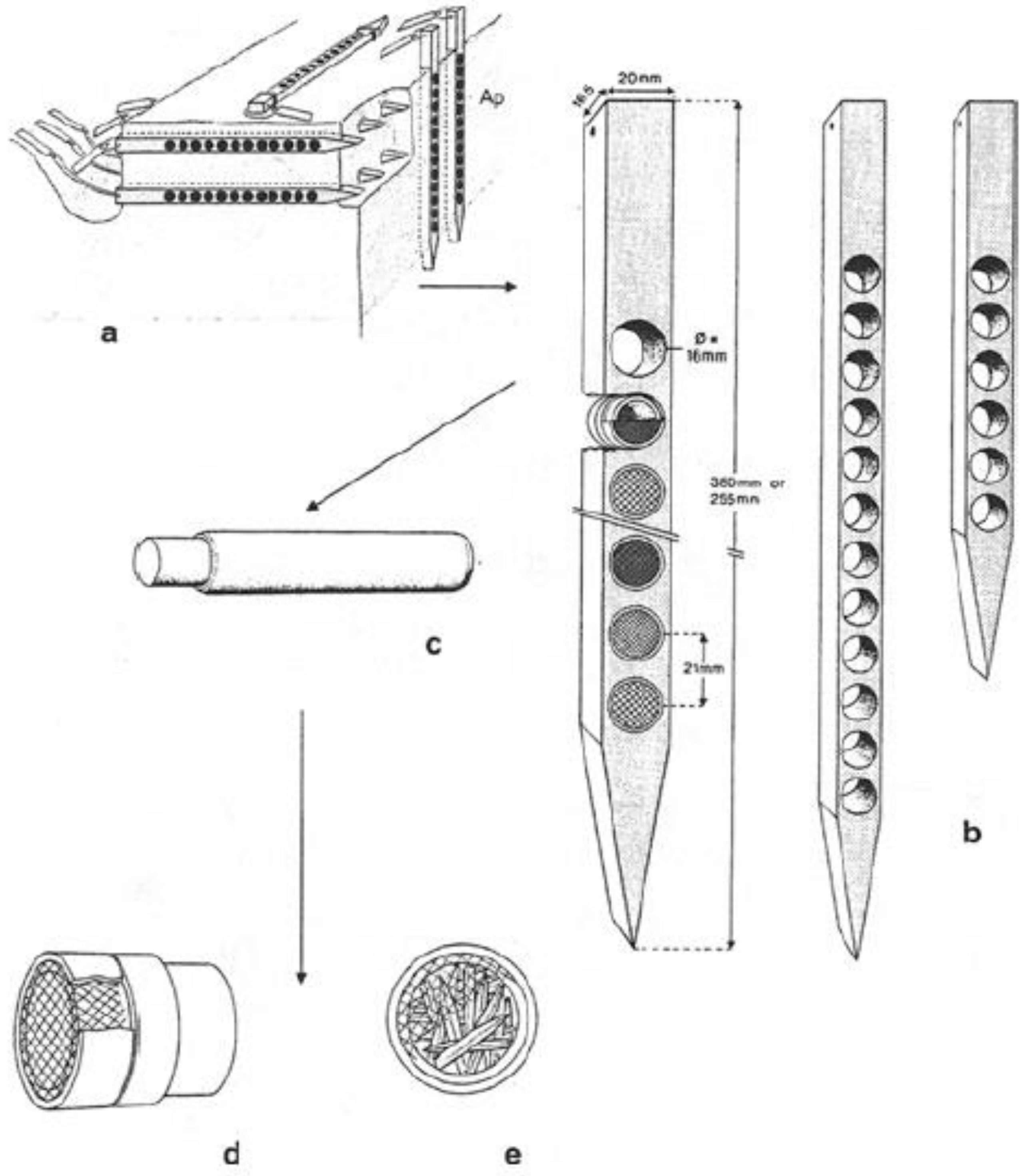
Planned experiments

1) Roots
2) Soil composition
3) **Soil biocoenosis**

- Evaluation of the degradation performance of the fauna in the soil using the Microcontainer Test (Eisenbeis et al. 1999)
- How well or effectively are hemp roots decomposed by destruents in the soil?
- Includes the fragmentation and shredding of organic residues as well as the chemical degradation of the material used (e.g. hemp roots)

Microcontainer Test

- Test system consists of 2 components:
  - PCV rod as carrier for the microcontainers
  - Microcontainer
- Microcontainers are small cylinders that contain the substrate and are closed with a net at both ends
  - Substrate used: hemp roots, wheat straw
    - Crushed to 6 mm and 2 mm
- Depending on the mesh size, the degradation performance of different destruents can be investigated
  - Mesh size of the net: 200 µm (microfauna) and 1500 µm (mesofauna)



Microcontainer test setup (Eisenbeis et al. 1999).

Microcontainer Test

Procedure of the experiment:

Filling of microcontainers and distribution in the field

↓

Removal of rods over the entire vegetation period of the industrial hemp (monthly)

↓

Evaluation of the degradation performance via the change in weight of the substrate used

Distribution of the Microcotainers in the field.

Planned experiments

1) Roots
2) Soil composition
3) Soil biocoenosis
4) **Further investigations in the climate chamber**

Parameters to be investigated:

- Nutrient deficiency
- Water deficiency
- Influence of Plant Growth Promoting Rhizobacteria (PGPR)

Plant growth promoting Rhizobacteria (PGPR)

- Bacteria that can promote plant growth by interacting especially with the roots of the plants
- PGPR are bacteria of the genus: *Azotobacter*, *Azospirillum*, *Bacillus*, *Agrobacterium*, …

<u>Possible positive effects of PGPR:</u>

- Stimulation of plant growth
- Yield increase
- Reduction of infection with pathogens
- Reduction of abiotic (drought, high salt content in the soil) and biotic stress (pathogens)
- Stimulation of the production of secondary metabolites in the plant (Di Benedetto et al. 2017)

Plant growth promoting Rhizobacteria (PGPR)

Experimental setup:

Inoculation:

- Control: Medium without bacteria
- Inoculation with bacteria: Use 100 ml medium with resuspended bacterial cells (2 g cells/L)

Evaluation of the experiment:

- Plant parameters: Root and shoot length, wet and dry mass of roots and shoots
- Soil parameters: Nutrient, water and hummus content

Cultivation of bacteria

↓

Sterilization and sowing of hemp seeds

↓

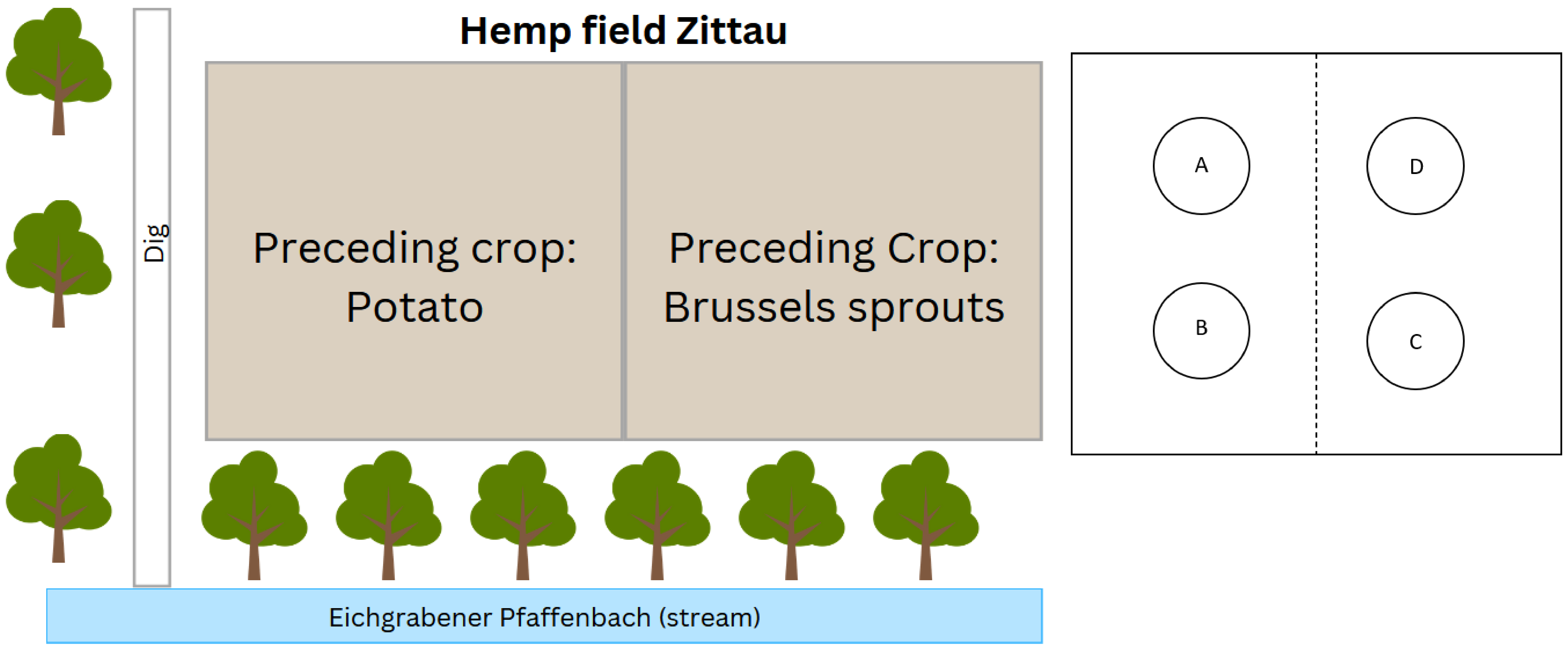
Inoculation of hemp with bacteria (weekly)

↓

Evaluation of the experiment after 6-9 weeks

First results

1) Roots

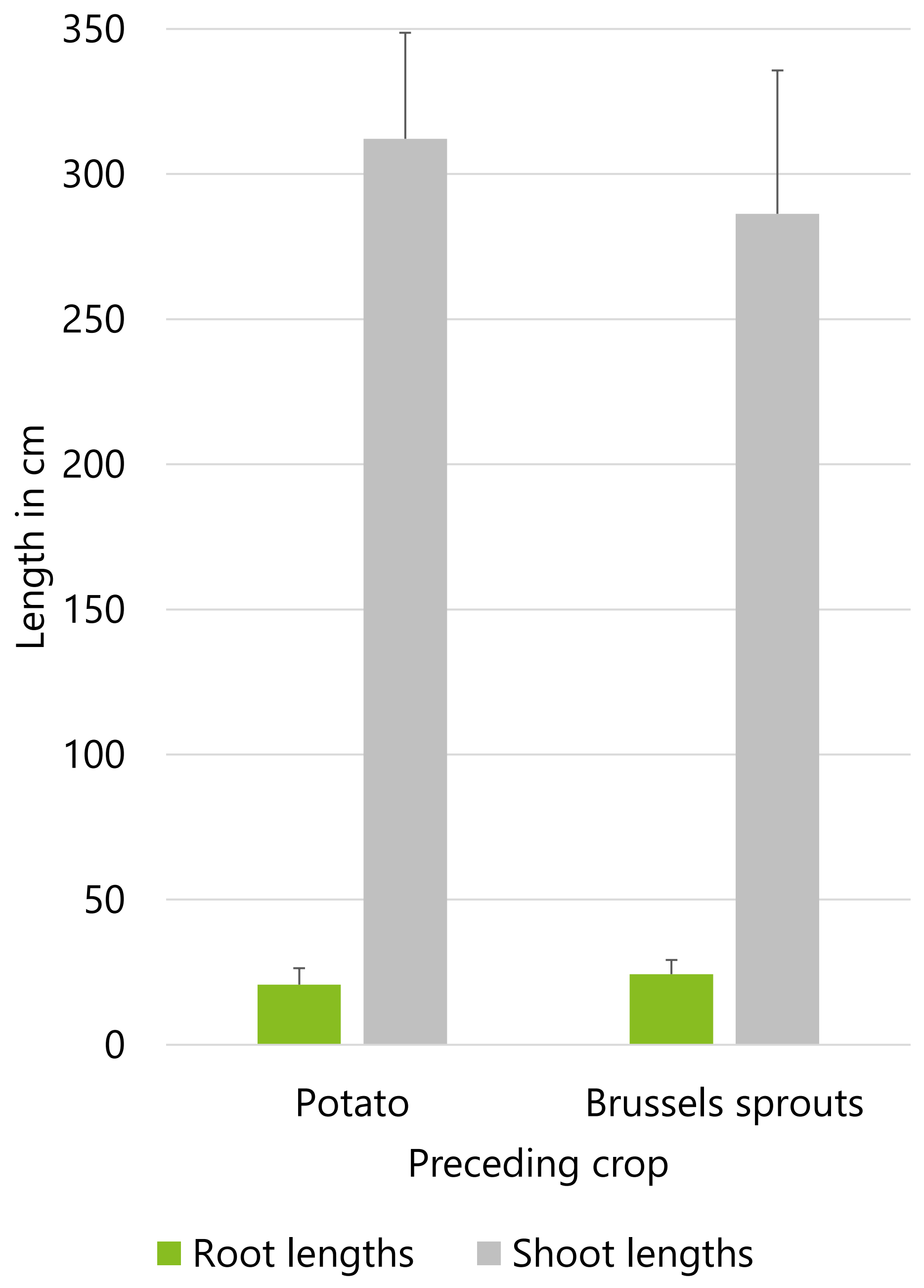


Hemp field Zittau. Graphic depiction of the preceding crop and the experimental groups.

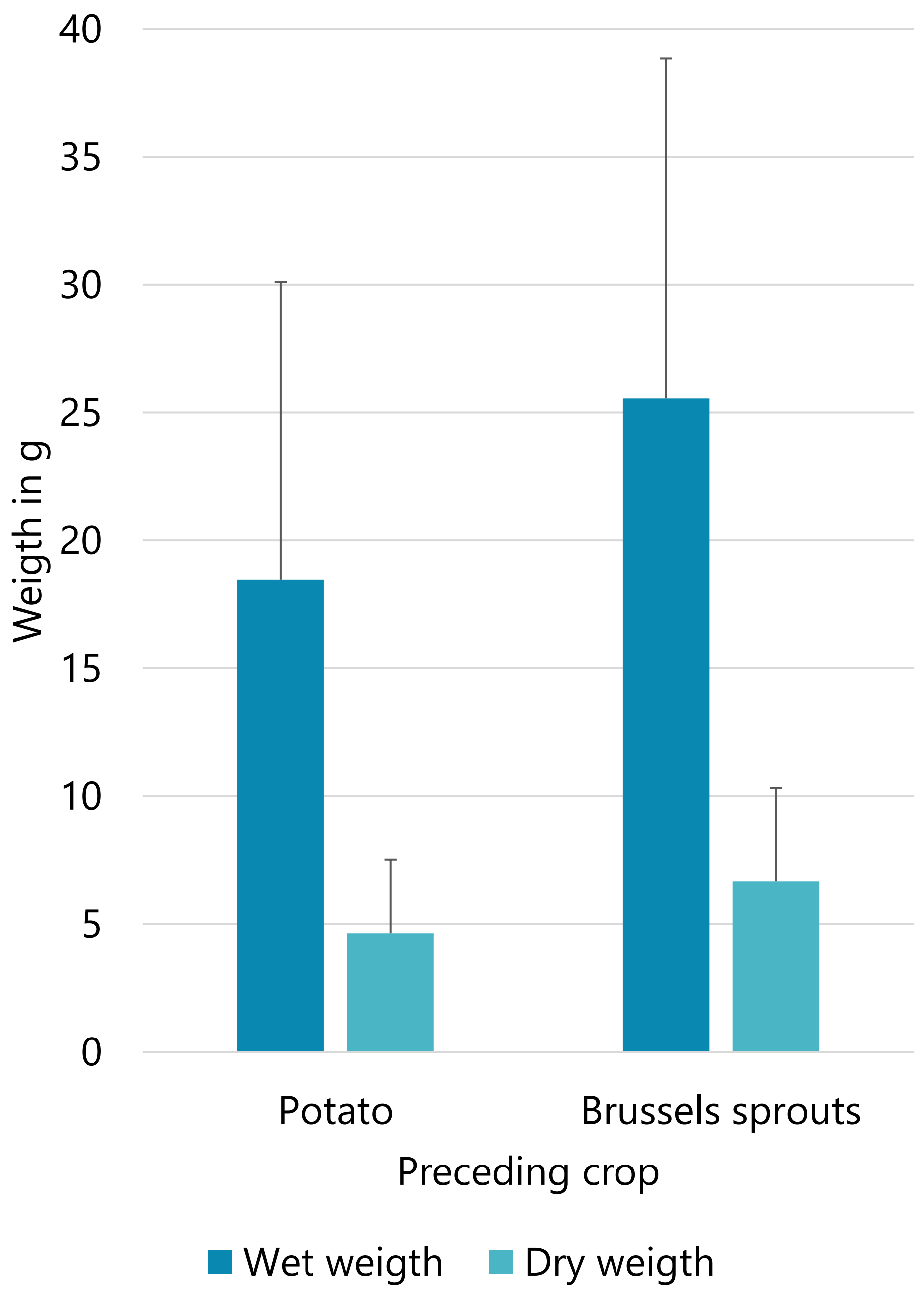
- Root and shoot samples obtained in 2024 from the hemp field in Zittau
- Special feature: Different preceding crop on the two halves of the cultivated area
- Statistically significant differences ($p<0,05$) in shoot and root parameters due to preceding crop recognizable
  - Experimental group A, B: Potato
  - Experimental group C, D: Brussels sprouts

First results

1) Roots



Shoot and root length of the harvested hemp.



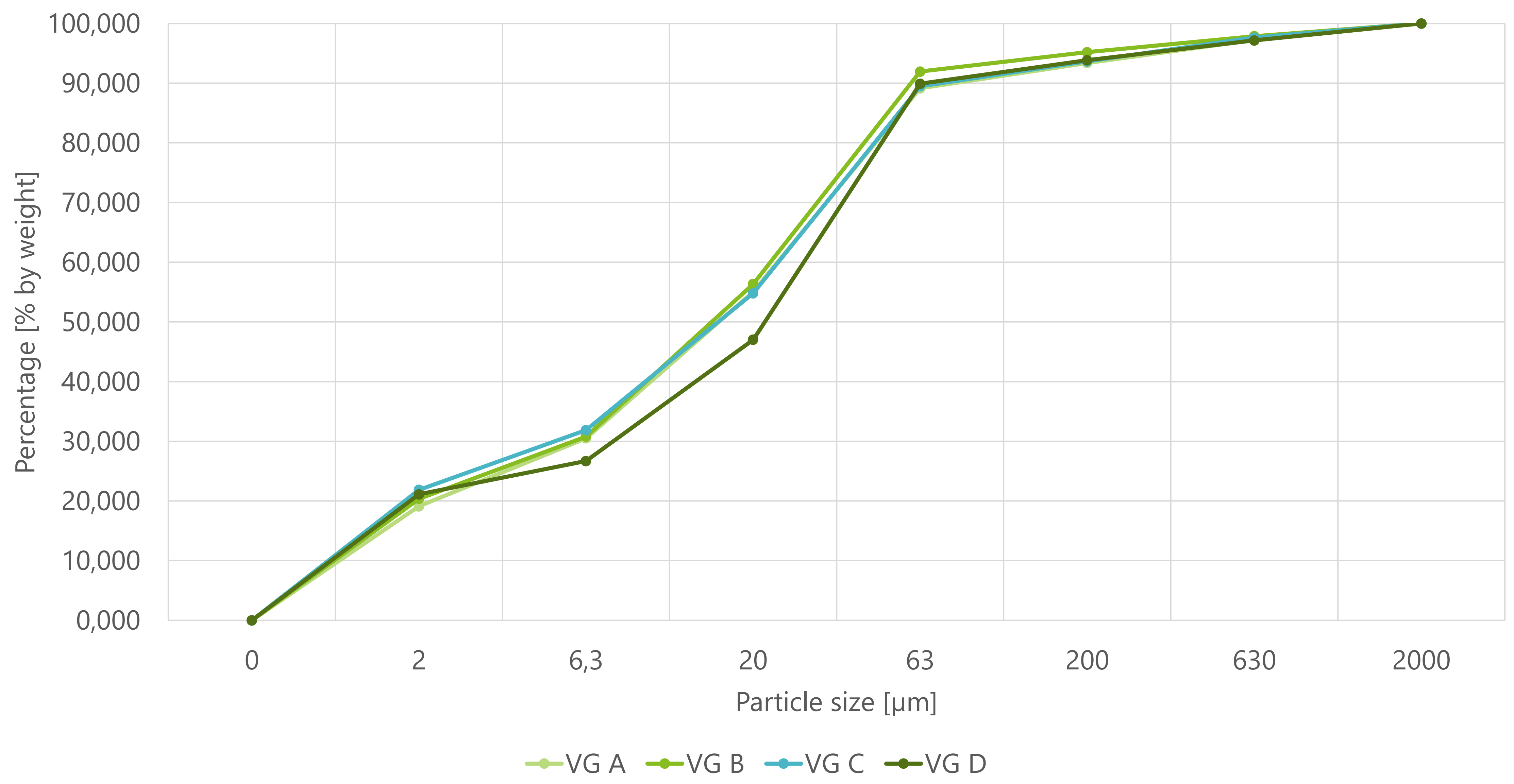
Wet and dry weight of the harvested hemp roots.

- Age of the plants: 120 days
- Brussels sprouts 15 % longer roots, but 8 % shorter shoots
  - Proportion of roots to shoots higher for Brussels sprouts
- The longer roots increase the wet weight by 28 % and the dry weight by 31 % on the Brussels sprout half

First results

1) Roots

2) **Soil composition**



Particle size distribution of the individual test groups.

Hemp field Zittau (2024)

- Humus content: 5,73 %
- Water content: 11,5 %
- Nutrient concentrations:
  - Nitrate: 186 mg/kg soil
  - Phosphate: 180 mg/kg soil
  - Ammonium: 1 mg/kg soil
- Soil type: heavy clay silt

Thank you for your attention.

If you have questions, feel free to contact us:

Jennifer.Dutschke@hszg.de

Lena_Victoria.Wehnert@hszg.de

Lukas.Vesely@hszg.de

Hochschule Zittau/Görlitz
UNIVERSITY OF APPLIED SCIENCES

ZIRKON

Hochschule Zittau/Görlitz
UNIVERSITY OF APPLIED SCIENCES

Sources

- Ryz, Natasha R.; Remillard, David J.; Russo, Ethan B. (2017): Cannabis Roots: A Traditional Therapy with Future Potential for Treating Inflammation and Pain. In: Cannabis and cannabinoid research 2 (1), S. 210–216. DOI: 10.1089/can.2017.0028.
- Eisenbeis, G.; Lenz, R.; Heiber, T. (1999): Organic residue decomposition: The minicontainer-system a multifunctional tool in decomposition studies. In: Environmental science and pollution research international 6 (4), S. 220–224. DOI: 10.1007/BF02987332.
- Di Benedetto, Nilde Antonella; Corbo, Maria Rosaria; Campaniello, Daniela; Cataldi, Mariagrazia Pia; Bevilacqua, Antonio; Sinigaglia, Milena; Flagella, Zina (2017): The role of Plant Growth Promoting Bacteria in improving nitrogen use efficiency for sustainable crop production: a focus on wheat. In: AIMSMICRO 3 (3), S. 413–434. DOI: 10.3934/microbiol.2017.3.413.