



**KGEV**

katedra geoenvironmentálních věd

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# Solving of drought: Application of biochar in order to increase retention capacity of soil

*This topic offers a multidisciplinary solution to currently highlighted issues such as drought, sustainable agriculture, limitation of nutrient leakage from soil, and also reducing CO<sub>2</sub> emissions into the air. All of the above mentioned issues are linked to a common denominator, such as climate change and its associated impacts. This topic is primarily focused on the possibilities of reducing the negative impact of drought episodes in the field of agriculture. For a successful drought resolution, it is important to understand the key soil processes which can minimize the negative impact of climate change. One of these key processes are the hydraulic*



*properties of soils as a set of soil characteristics responsible for water distribution in the soil. These parameters are variable in time and have a number of factors, when one of this is the presence of organic material. This topic is, therefore, focused on the determination of factors responsible for the natural seasonal variability of hydraulic properties and the subsequent solution how to increase the soil water retention after the biochar application. Biochar should therefore have a positive impact on (1) the ability of the soil to fix water as well as the fundamental nutrients (including also other substances); furthermore, (2) its stability in the environment should also be demonstrated; (3) including the resulting impact on increased microbial activity in soil and a positive impact on plant growth.*

## Scientific aims:

- Optimization of biochar production for the purpose of significant increasing of water/nutrients retention in soil
- Preparation of a new substrate (composite of biochar with compost)
- Influence of biochar on soil hydraulic properties and increase of microbial activity of different soil types, including determination of soil stability
- Monitoring of the biomass production and stress factors on selected crops (plants)
- Field experiments (meteorological stations) at selected locations - verification of laboratory results
- Description and modelling of natural seasonal variability of the soil hydraulic properties at different types of landscape and determining the factors causing these variables
- Modelling approach which has not yet reflected the time variability of hydraulic properties

## Background and Obligations of Ph.D. student:

- Four-year study; time flexibility; active participation at international conferences
- Publication activity<sup>1</sup> (at least 1 publication in the journal with IF<sup>2</sup> as first author during study)
- Pedagogical activities<sup>3</sup> (practices at Environmental Hydrogeology, Hydropedology, Hydrological modelling subjects, consultations on bachelor and diploma theses related to this subject)
- Obligation to complete a 4-week international internship within this topic (e.g. The James Hutton Institute, Aberdeen, Scotland, PhytoRec-Environmental Technologies Team, CEBAS-CSIC, Murcia, Spain, SCK • CEN, Mol, Belgium, BOKU, Vienna, Austria)
- Scholarship (average 11,300 CZK); possibility to get an internal faculty project up to 3 years (increase of scholarship up to 80,000 CZK per year); obtaining extraordinary scholarships (for extra-standard publishing activity or pedagogical practices<sup>4</sup>)
- The offer of another technician's work at IH CAS (40% for 10,000 CZK); eventual participation at projects (contract approx. 150 CZK per hour) **with 100% load monthly salary up to approx. 37,000 CZK per month (1,460€)!!!**

## Research team:

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## Projects:

**Financed project:** CZ.07.1.02/0.0/0.0/16\_040/0000368 (European Structural and Investment Funds OP PPR) Outputs of science and research for environmental practice; concept - Production of stable garden substrate from bio-waste "KompoChar" (CZK 5.1 mil; 2017 – 2020)

**Submitted project:** 19-02725S (GAČR) Monitoring of temporal variability and the effect of presented biochar to changes in soil hydraulic properties (CZK 8.0 mil; 2019 – 2021)

**Submitted project:** QK1910056 (NAZV) Long-term test of the biochar application produced from waste biomass to solve drought in intensively farmed areas of the Czech Republic (CZK 15.2 mil; 2019 – 2023)

## References:

**Soudek, P.,** Rodriguez Valseca, I.M., Petrová, Š., Song, J., Vaněk, T., (2017): Characteristics of different types of biochar and effects on the toxicity of heavy metals to germinating sorghum seeds. *Journal of Geochemical Exploration* 182, 157–165.

**Šípek, V., Tesař, M.** (2017): Year-round estimation of soil moisture content using temporally variable soil hydraulic parameters. *Hydrological Processes* 31, 1438–1452.

**Trakal, L.,** Raya-Moreno, I., Mitchell, K., Beesley, L. (2017): Stabilization of metal(loid)s in two contaminated agricultural soils: Comparing biochar to its non-pyrolised source material. *Chemosphere* 181, 150–159.

**Šípek, V., Tesař, M.** (2016): Validation of a mesoscale hydrological model in a small-scale forested catchment. *Hydrology Research* 47(1), 27–41.

**Trakal, L.,** Veselská, V., Šafařík, I., Vítková, M., Číhalová, S., Komárek M. (2016): Lead and cadmium sorption mechanisms on magnetically modified biochars. *Bioresource Technology* 203, 318–324.

**Jačka, L.,** Pavlásek, J., Kuráž, V., Pech, P. (2014): A comparison of three measuring methods for estimating the saturated hydraulic conductivity in the shallow subsurface layer of mountain podzols. *Geoderma* 219, 82–88.

**Trakal, L.,** Bingöl, D., **Pohořelý, M.,** Hruška, M., Komárek, M. (2014): Geochemical and spectroscopic investigations of Cd and Pb sorption mechanisms on contrasting biochars: Engineering implications. *Bioresource Technology* 171, 442–451.

<sup>1</sup> In the case of above-standard publishing activities (at least 3 publications) the possibility of writing a dissertation in the form of an annotated work

<sup>2</sup> Publication with impact factor according to Web of Science

<sup>3</sup> The scholarship is gradually increasing along with the fulfilled obligations of the PhD student (9,300 - 13,000 CZK)

<sup>4</sup> Teaching activity over 192 teaching hours until the end of the 3rd year of study