Ecotoxicity of biochars from organic wastes focusing on their use as soil ameliorant

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Introduction

Biochar is the product of thermal degradation of organic waste materials by pyrolysis. It may improve soil fertility, as well as other ecosystem services and sequester carbon to mitigate climate change. The feedstock affects several biochar properties with agronomic implications, including ash content, the H/C ratio, surface area and ion exchange (Lehmann and Joseph, 2009). In spite of the positive effects on the soil, increasing attention is paid on biochar contamination with PAHs and trace metals, therefore posing a potential threat to the environment, a fact confirmed by ecotoxicity tests (Oleszczuk *et al*., 2013).

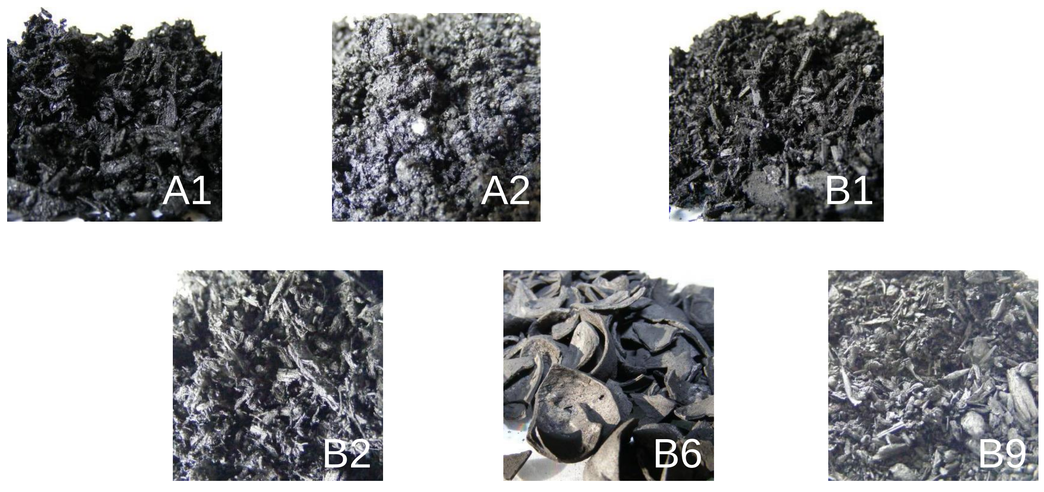
Aims

This study has the aim to assess the biological and ecotoxicological properties of 13 biochars from two producers and to recommend the best fitting biochar for improvement of the quality of sandy soils.

List of biochars based on feedstock

- Grain husks and paper fibre sludge (A1)
- A1 post treated with stone powder and compost (A2)
- A1, digestate and minerals: stone powder, P and Fe (A3)
- A3 post treated with organic liquid (A4)
- Wood screenings (B1)
- *Miscanthus* (B2)
- Vine (B3)
- Black cherry (B4)
- Straw (B5)
- Hazelnut shells (B6)
- Meadow (B7)
- Natural biomass (B8)
- Spelts mixed with paper (2:1) (B9)

Made in PYREG® type pyrolyzer, „A” at 450−500 °C for 20 min., „B” at 600−700 °C for 15 min.



Selected results

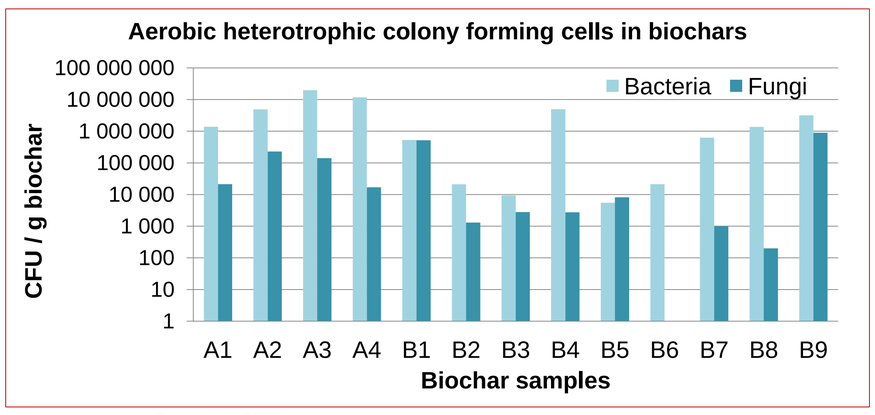


Figure 1. CFU in biochars determined by plate count method

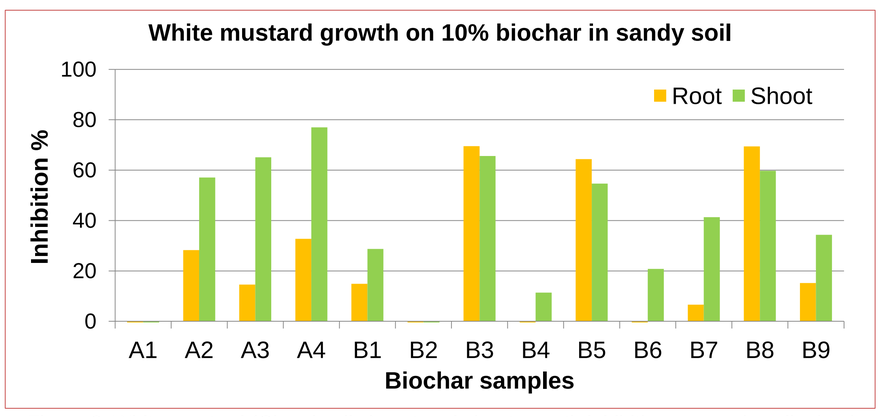


Figure 2. White mustard (*Sinapis alba*) root and shoot growth inhibition on sandy soil mixed with 10 weight% biochar. Calculated for sandy soil as control.

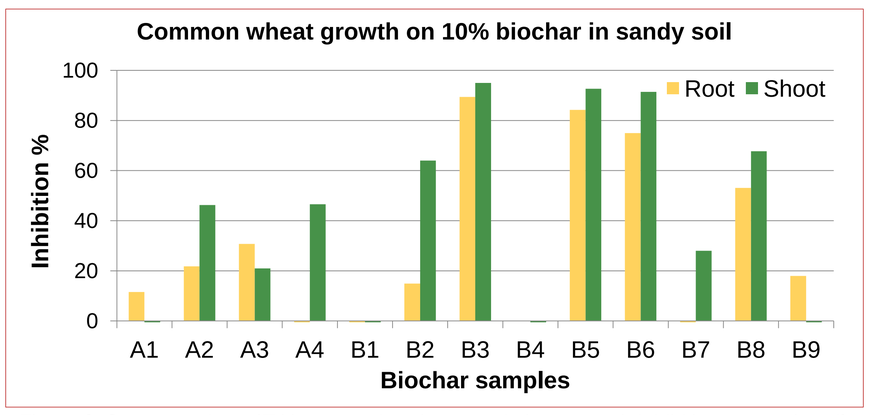


Figure 3. Common wheat (*Triticum aestivum*) root and shoot growth inhibition on sandy soil mixed with 10 weight% biochar. Calculated for sandy soil as control.

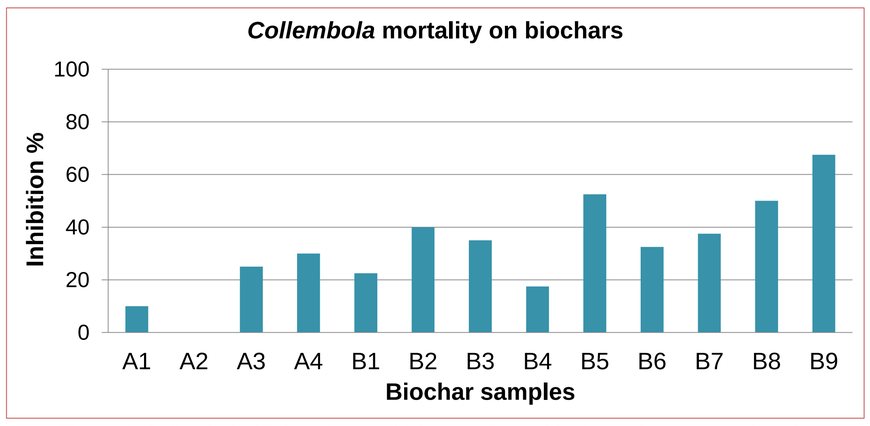


Figure 4. Collembola (*Folsomia candida*) mortality on biochars. Control: sandy soil.

Ranking and conclusions

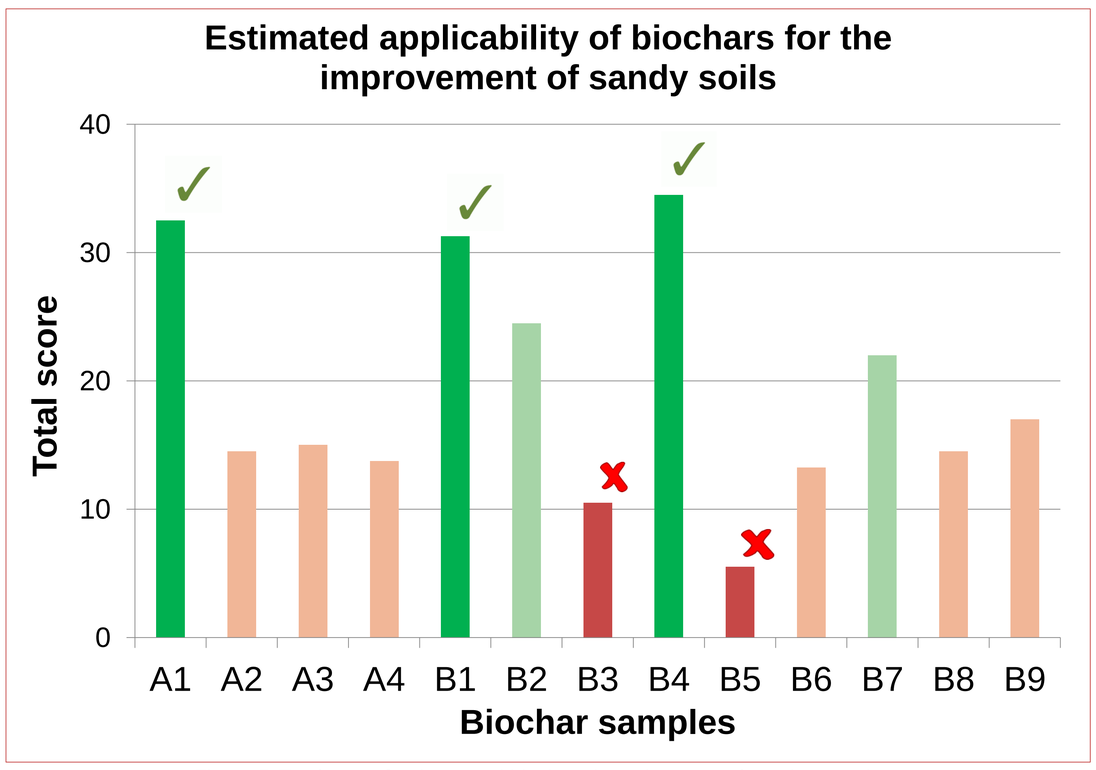


Figure 5. Total score for the tested biochars based on ten selected properties. (-)5 − (+)5 points for each tested property. Higher total score indicates better performance.

Based on the created scoring system it was confirmed that physical, chemical, biological (Fig. 1) and ecotoxicological (Fig. 2−4) properties of the assessed 13 biochars depend greatly on the pyrolyzed feedstock type (Fig. 5). The biochars from grain husk and paper fibre sludge, wood screenings and black cherry had the most favourable properties (eg. habitat for microbes, no toxic effect on test plants and animals, toxic element content under limit value, alkaline pH, water holding capacity >100%) regarding their application as soil ameliorant in sandy soils. Therefore as the next step of our experiments we will apply these biochars in soil microcosms and field plots for the improvement of sandy soils.

References

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Oleszczuk P, Josko I, Kusmierz M. 2013. Biochar properties regarding to contaminants content and ecotoxicological assessment. J. of Hazardous Materials, 260, 375–382

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