JOURNAL OF ENVIRONMENTAL ENGINEERING AND LANDSCAPE MANAGEMENT
ISSN 1648–6897 / eISSN 1822-4199
2017 Volume 25(02): 83–85
https://doi.org/10.3846/16486897.2017.1319376

The special issue on
Biochar as an Option for Sustainable Resource Management

Editorial

EDITORIAL: SPECIAL ISSUE ON BIOCHAR AS AN OPTION FOR SUSTAINABLE RESOURCE MANAGEMENT (EU COST ACTION TD1107 FINAL PUBLICATION)

Bruno GLASER[a], Pranas BALTRĖNAS[b], Claudia KAMMANN[c], Jürgen KERN[d], Edita BALTRĖNAITĖ[e]

[a]*Martin Luther University Halle-Wittenberg, Institute of Agronomy and Nutritional Sciences, Soil Biogeochemistry, 06120 Halle/Saale Germany*
[b]*Institute of Environmental Protection, Faculty of Environmental Engineering, Vilnius Gediminas Technical University, Saulėtekio al. 11, LT-10223 Vilnius, Lithuania*
[c]*Hochschule Geisenheim University, Soil Science and Plant Nutrition, Von-Lade Str. 1, Geisenheim 65366, Germany*
[d]*Leibniz Institute for Agricultural Engineering and Bioeconomy, Bioengineering, Max-Eyth-Allee 100, Potsdam 14469, Germany*
[e]*Department of Environmental Protection, Institute of Environmental Protection, Faculty of Environmental Engineering, Vilnius Gediminas Technical University, Saulėtekio al. 11, LT-10223 Vilnius, Lithuania*

10 Apr. 2017

Abstract. The articles appearing in this special issue on *Biochar as an Option for Sustainable Resource Management* are mainly the extended versions of the contributions presented in Biochar COST Action meetings, especially at the International Biochar conference held September 2015 at Geisenheim University (Germany), which was the final conference of the COST Action TD1107.

Keywords: biochar, editorial, sustainable resources management, Biochar COST Action.

The Biochar COST Action (TD1107) was initiated by Jürgen Kern, Claudia Kammann and Bruno Glaser, mainly with the goals to minimize fragmented biochar research and technology development across Europe and to accelerate implementation of proper biochar technologies within Europe.

The articles appearing in this special issue on *Biochar as an Option for Sustainable Resource Management* are the extended versions of the contributions presented at various meetings during the EU COST Action TD1107 such as a meeting on identification of research gaps held in Aveiro (Portugal), a meeting on biochar as option to replace peat in growing media held in Tartu (Estonia) and the International Biochar conference 2015 at Geisenheim University (Germany), which was the final conference of the COST Action TD1107. The conference aimed at understanding biochar mechanisms, which are crucial for beneficial and safe biochar technology implementation.

Nine articles, covering the main aspects of the conference session topics as well as major results of the COST Action are presented. Tammeorg *et al.* (2017, this issue) explored the current level of scientific understanding regarding the consequences of biochar application to soil and presented five broad thematic areas of biochar research: ***soil biodiversity and ecotoxicology, soil organic matter and greenhouse gas (GHG) emissions, soil***

Corresponding author: Bruno Glaser
E-mail: bruno.glaser@landw.uni-halle.de

physical properties, nutrient cycles and crop production, and soil remediation. The highest future research priorities regarding biochar's effects in soils were functional redundancy within soil microbial communities, bioavailability of biochar's contaminants to soil biota, soil organic matter stability, GHG emissions, soil formation, soil hydrology, nutrient cycling due to microbial priming as well as altered rhizosphere ecology, and soil pH buffering capacity.

Peat soils represent the highest concentrations of organic matter in all soils. Currently, the area of peatland in the European Union is more than 318 000 km^2, mainly in the Northern parts. At the global level, peatlands hold at least 1/5 of the total soil carbon pool, which is equivalent to approximately half the amount of CO_2 in the atmosphere. Peat is widely used as a high quality substrate for growing media in horticulture. Due to unsustainable peat extraction damaging peatland ecosystems, a large extent of peatlands in Central and South Europe is rapidly disappearing. The disturbed peatlands are becoming a source of greenhouse gases due to drainage and excavation. Kern *et al.* (2017, this issue) suggested that biochar might play a more important role in replacing peat in growing media, but such biochar should be available, meet the quality requirements, and its use must be economically feasible. First positive results from laboratory and greenhouse experiments have been reported with ***biochar content in growing media ranging up to 50%***. When addressing the effect of biochar on plant health and the suppression of diseases, Frenkel *et al.* (2017, this issue) concluded that biochar may have also positive effects on plant health even at low concentrations below 1% by suppressing several diseases. For use as horticultural peat replacement, it was recommended that biochar feedstocks and concentrations must be standardized and the potential effect of biochar on plant disease should be considered, so that growers can rely on consistent and reproducible biochars for desired effects.

It is known that agriculture and land use change has significantly increased atmospheric emissions of the non-CO_2 greenhouse gases (GHG) nitrous oxide (N_2O) and methane (CH_4). Since human nutritional and bioenergy needs continue to increase, at a shrinking global land area for production, novel land management strategies are required that reduce the GHG footprint per unit of yield. Kammann *et al.* (2017, this issue) reviewed the current state of knowledge on the potential of biochar to reduce N_2O and CH_4 emissions from agricultural practices including potential mechanisms behind observed effects. The researchers identified several under-explored fields of research for using biochar to reduce farming-related GHG emissions, including the use of biochar as fertilizer carrier, in manure treatment or animal feeding. They concluded ***that the largest future research needs are lifecycle GHG assessments when using biochar as an on-farm management tool for nutrient-rich biomass waste streams***.

As shown by Latawiec *et al.* (2017, this issue), the positive effect of biochar among potential climate change mitigation strategies could be particularly relevant for countries with limited alternatives. Scaling up a mitigation technology that is viable on account of its co-benefits might be cost-effective, which could, in turn, adjust national perspectives and stronger involvement in developing mitigation policies at the regional level. ***Biochar has much promise in temperate conditions and further research should therefore be assigned to explore biochar's environmental and socio-economic impacts***.

When discussing the option of biochar technologies, Hilber *et al.* (2017, this issue) stressed that biochar itself can contain organic contaminants such as polycyclic aromatic hydrocarbons or heavy metals. As the distribution coefficients of biochar especially for contaminants are high, the freely dissolved concentrations are low and with that also the bioavailability. The biochar's potential to remediate contaminated soils has mainly been addressed in laboratory studies, but rarely in the field. Many studies reported successful immobilization of contaminants but some not, therefore, ***the ambivalent face of the biochar with regard to contaminants prevails***.

The representativeness of European biochar research was analyzed by Verheijen *et al.* (2017, this issue) for field experiments (Part I) and Sakrabani *et al.* (2017, this issue) for pot and laboratory experiments (Part II). The focus has been how representatively has each pot or field experiment been compared to existing variations in soil types, climate, vegetation etc, so that this can be used to identify gaps in which research is lacking. As suggested for future research, Verheijen *et al.* (2017, this issue) observed that biochar use for soil contamination and remediation was the least represented theme and ***the potential of different biochars for remediation of contaminants need more research attention***. Sakrabani *et al.* (2017, this issue) suggested ***to contextualize the effects of biochar on soil properties***.

For the sustainable use and application of biochar, most researchers pointed out the need to to standardize analytical biochar characterization, to match biochar types with its intended use and to harmonize the related legislation accordingly. In the opinion of Meyer *et al.* (2017, this issue), the national and supranational legislation in the EU is not yet adequately prepared to regulate both the production and the application of biochar. Driven by this "regulatory gap", voluntary biochar quality standards have been formed in Europe with the European Biochar Certificate, in the UK with the Biochar Quality Mandate and in the USA with the International Biochar Initiative Standards, which is intended to be used internationally. In parallel to this, biochar producers and biochar users in a number of EU countries were partly successful in fitting the new biochar product into the existing national legislation for fertilisers, soil improvers and composts. The intended revision of the EC Regulation 2003/2003 on fertilisers offers the opportunity to regulate the use of biochar at the EU level. ***It was suggested to carry out systematic research to use suitable biochar quality grades for different soil application purposes***. Such systematic research could also be useful for the development of the quality grades for the broader use of biochar (e.g. environmental protection technologies).

Acknowledgements

As editors, we would like to take this opportunity to thank all the authors for their contributions to this special issue, and the reviewers for their expert review comments. Finally, we gratefully acknowledge that this special issue with its Open Access was financially supported by the COST Action TD1107.

References

Frenkel, O.; Jaiswal, A. K.; Elad, Y.; Lew, B.; Kammann, C.; Graber, E. R. 2017. The effect of biochar on plant diseases: what should we learn while designing biochar substrates?, *Journal of Environmental Engineering and Landscape Management* 25(02): 105–113 (this issue).

Hilber, I.; Bastos, A. C.; Loureiro, S.; Soja, G.; Marsz, A.; Cornelissen, G.; Bucheli, T. D. 2017. The different faces of biochar: contamination risk versus remediation tool, *Journal of Environmental Engineering and Landscape Management* 25(02): 86–104 (this issue).

Kammann, C.; Ippolito, J.; Hagemann, N.; Borchard, N.; Luzcayuela, M.; Estavillo, J. M.; Fuertes-Mendizabal, T.; Jeffery, S.; Kern, J.; Novak, J.; Rasse, D.; Saarnio, S.; Schmidt, H.-P.; Spokas, K.; Wrage-Mönnig, N. 2017. Biochar as a tool to reduce the agricultural greenhouse-gas burden – knowns, unknowns and future research needs, *Journal of Environmental Engineering and Landscape Management* 25(02): 114–139 (this issue).

Kern, J.; Tammeorg, P.; Shanskiy, M.; Sakrabani, R.; Knicker, H.; Kammann, C.; Tuhkanen, E. M.; Smidth, G.; Prasadi, M.; Tiilikkala, K.; Sohi, S.; Gasco, G.; Glaser, B. 2017. Synergistic use of peat and char materials in growing media – one option reducing the pressure on peatlands?, *Journal of Environmental Engineering and Landscape Management* 25(02): 160–174 (this issue).

Latawiec, A. E.; Peake, L.; Baxter, H.; Cornelissen, G.; Grotkiewicz, K.; Hale, S.; Królczyk, J. B.; Kubon, M.; Łopatka, A.; Medynska-Juraszek, A.; Reid, B.; Siebielec, G.; Sohi, S. P.; Spiak, Z.; Strassburg, B. B. N. 2017. A reconnaissance-scale GIS-based multicriteria decision analysis to support sustainable biochar use: Poland as a case study, *Journal of Environmental Engineering and Landscape Management* 25(02): 208–222 (this issue).

Meyer, S.; Genesio, L.; Vogel, I.; Schmidt, H.-P.; Soja, G.; Someus, E.; Shackley, S.; Verheijen, F. G. A.; Glaser, B. 2017. Biochar standardization and legislation harmonization, *Journal of Environmental Engineering and Landscape Management* 25(02): 175–191 (this issue).

Regulation (EC) No 2003/2003 of the European Parliament and of the Council of 13 October 2003 relating to fertilisers, *Official Journal of European Union*, 2003.

Sakrabani, R.; Kern, J.; Mankasingh, U.; Zavalloni, C.; Zanchettin, G.; Bastos, A. C.; Tammeorg, P.; Jeffery, S.; Glaser, B.; Verheijen, F. G. A. 2017. Representativeness of European biochar research: part II – pot and laboratory studies, *Journal of Environmental Engineering and Landscape Management* 25(02): 152–159 (this issue).

Tammeorg, P.; Bastos, A. C.; Jeffery, S.; Rees, F.; Kern, J.; Graber, E. R.; Ventura, M.; Kibblewhite, M.; Amaro, A.; Budai, A.; Cordovil, C. M. S.; Domene, X.; Gardi, C.; Gascó, G.; Horák, J.; Kammann, C.; Kondrlova, E.; Laird, D.; Loureiro, S.; Martins, M. A. S.; Panzacchi, P.; Prasad, M.; Prodana, M.; Puga, A. P.; Ruysschaert, G.; Sas-Paszt, L.; Silva, F. C.; Teixeira, W. G.; Tonon, G.; delle Vedove, G.; Zavalloni, C.; Glaser, B.; Verheijen, F. G. A. 2017. Biochars in soils: towards the required level of scientific understanding, *Journal of Environmental Engineering and Landscape Management* 25(02): 192–207 (this issue).

Verheijen, F. G. A.; Mankasingh, U.; Penizek, V.; Panzacchi, P.; Glaser, B.; Jeffery, S.; Bastos, A. C.; Harter, J.; Tammeorg, P.; Kern, J.; Zavalloni, C.; Zanchettin, G.; Sakrabani, R. 2017. Representativeness of European biochar research: Part I – field experiments, *Journal of Environmental Engineering and Landscape Management* 25(02): 140–151 (this issue).

Bruno GLASER. PhD, Professor of Soil Biogeochemistry, Institute of Agronomy and Nutritional Sciences, Martin Luther University Halle-Wittenberg, Germany, 137 peer-reviewed articles in scientific journals, H-index 37 (WoS).

Pranas BALTRĖNAS. Professor-Emeritus, Dr. Habil, Founder of the Department and Institute of Environmental Protection and the Journal of Environmental Engineering and Landscape Management, Vilnius Gediminas Technical University, Lithuania, 346 peer-reviewed papers in scientific journals, 94 patents, 17 monographs, 3 textbooks, 3 book chapters, H-index 12 (WoS).

Claudia KAMMANN. PhD, Professor for Climate Change Research for Special Crops, Institute for Soil Science and Plant Nutrition, Hochschule Geisenheim University, Geisenheim, Germany, 58 peer-reviewed articles in scientific journals, 7 book chapters, 2453 citations, H-index 27 (Google Scholar).

Jürgen KERN. PhD, Senior Scientist of Biogeochemistry, Leibniz Institute for Agricultural Engineering Potsdam-Bornim, Germany, 1211 citations, H-index 16 (Google Scholar).

Edita BALTRĖNAITĖ. Dr., Professor of Environmental Engineering and Landscape Management, Vilnius Gediminas Technical University, Lithuania, 64 peer-reviewed papers in scientific journals, 2 monographs, 3 book chapters, H-index 9 (WoS).