Characteristics and nutrient values of biochars produced from giant reed at different temperatures

Hao Zheng, Zhenyu Wang, Xia Deng, Jian Zhao, Ye Luo, Jeff Novak, Stephen Herbert, Baoshan Xing

College of Environmental Science and Engineering, Ocean University of China, Qingdao 266100, China
Stockbridge School of Agriculture, University of Massachusetts, Amherst, MA 01003, USA
USDA-ARS Coastal Plain Soil, Water & Plant Research Center, 2611 W. Lucas Street, Florence, SC 29501, USA

Available N and P in biochar decreased with increasing temperature but K increased.
Less-soluble crystalline P minerals were formed in high-temperature biochar.
More NH$_4^+$, PO$_4^{3-}$ and K$^+$ were released from the biochars at low pH ($\leq$5).
Biochars released NH$_4^+$ slowly but released PO$_4^{3-}$ and K$^+$ fast.
Low-temperature biochars could be a good amendment for improving soil fertility.

1. Introduction

Biochar refers to the carbon-rich product from heating biomass in a closed system under limited oxygen supply. It is distinguished from charcoal by its use as a soil amendment (Lehmann and Joseph, 2009). It is a multifunctional material with environmental and agricultural applications (Atkinson et al., 2010; Beesley et al., 2011). Biochar is recognized as a high-efficient and low-cost sorbent for pollutants (Silber et al., 2010; Sun et al., 2011; Wang and Xing, 2007). Application of biochar to soil has been proposed as an approach to sequester carbon (Lehmann and Joseph, 2009) and to possibly reduce or suppress CO$_2$, CH$_4$ and N$_2$O emissions (Spokas et al., 2009). Most importantly, biochar may improve soil quality and nutrient availability to plants (Atkinson et al., 2010).

Although information on biochar nutrient properties are available (Atkinson et al., 2010; Chan et al., 2009; Lehmann and Joseph, 2009; Silber et al., 2010), the mechanism of nutrient release from biochar is not fully understood. Furthermore, total N, P and K (TN, TP and TK) in biochars may not necessarily reflect the actual availability of these nutrients to plants (Spokas et al., 2012). The influence of pyrolysis temperature on the production of biochars that are suitable as soil fertilizer still needs to be elucidated.

Due to its fast growth rate and good resistance to drought and floods, GR may yield up to 45 tons per hectare and life cycle