



## **Is current biochar soil study addressing global soil constraints for sustainable agriculture?**

Genxing Pan (1,2), Dengxiao Zhang (1), Ming Yan (1), Yaru Niu (1), Xiaoyu Liu (1), Lukas van Zwieten (3), De Chen (1), Rongjun Bian (1), Kun Cheng (1), Lianqing Li (1), Stephen Joseph (1,4), Jinwei Zheng (1), Xuhui Zhang (1), Jufeng Zheng (1), David Crowley (1), Timothy Filley (5,1)

(1) Nanjing Agricultural University, Nanjing, China (pangenxing@aliyun.com), (2) Center of Terrestrial carbon sink and Land remediation, Zhejiang Agro-Forestry University, Lin'an, Zhejiang 311350, China, (3) NSW Department of Primary Industries, Wollongbar, NSW 2477, Australia, (4) School of Materials Science and Engineering, University of New South Wales, Sydney, NSW 2052, Australia, (5) Department of Earth, Atmospheric, and Planetary Sciences, Purdue University, West Lafayette, IN 47907, USA

Global soil degradation has been increasingly threatened sustainability of world agriculture. Use of biochar from bio-wastes has been proposed as a global option for its great potential in tackling soil degradation and mitigating climate change in agriculture. For last 10 years, there have been greatly increasing interests in application of charred biomass, more recently termed biochar, as a soil amendment for addressing soil constraints for sustainable agriculture. Biochar soil studies could deliver reliable information for appropriate application of biochar to soils where for sustainable agriculture has been challenged. Here we review the literature of 798 publications reporting biochar soil studies by August, 2015 to address potential gaps in understanding of biochar's role in agriculture. We have found some substantial biases and gaps inherent in the current biochar studies. 1) The majority of published studies were from developed regions where the soils are less constrained and were much more frequent in laboratory and glasshouse pot experiments than field studies under realistic agriculture. 2) The published biochar soil studies have used more often small kiln or lab prepared biochar than commercial scale biochars, more often wood and municipal waste derived biochars than crop straw biochars. Overall, the lack of long-term well designed field studies using biochar produced in commercial processes may have limited our current understanding of biochar's potential to enhance global crop production and climate change mitigation. We have also recommended a global alliance between longer-term research experiments and biochar production facilities to foster the uptake of this important technology at a global scale.

Keywords: biochar, soil study, literature review, research gap, global perspective, quantitative assessment, sustainable agriculture