



## News from the International Biochar Initiative

IBI is a non-profit organization supporting researchers, commercial entities, policy makers, farmers & gardeners, development agents and others committed to sustainable biochar production and use.

Help put the Earth **Back in the Black**

### August 2012

#### IBI Hosts First-Ever U.S. Biochar Study Tour

IBI was honored to organize the first-ever U.S. Biochar Study Tour in late July/early August, to inform participants about biochar technologies in the U.S., visit biochar institutions, companies, and academic facilities, and to attend the 3<sup>rd</sup> United States Biochar Conference in Sonoma, California. The tour was funded by the blue moon fund and intended to promote the development of biochar investment in China and increased collaboration and partnerships in the field between the U.S. and China. There were 14 Chinese nationals participating, including representatives of the National Development and Reform Commission (NDRC), the Ministry of Finance, the Ministry of Agriculture, and the Global Environmental Institute of China.



The 9-day tour included a visit to the *Iowa State University Bio-Economy Center* in Ames, Iowa (which has extensive field trials using biochar and has a biochar and bio-oil production facility), a stop at *Rentech Inc.* in Colorado (a manufacturer focusing on larger scale biomass-to-energy systems, and who also just concluded a successful demonstration with United Airlines using half of their bio-fuel and half regular airplane fuel on a test flight), a tour at *Biochar Solutions* in Pueblo Colorado (a firm that designs, produces, and sells continuous process industrial equipment to convert forest residues into biochar and bioenergy, works on mineland reclamation with biochar, and has a biochar production facility), and a stop at *Bath Garden Center* in Colorado (a large family-owned business which produces, tests, and sells biochar and biochar-related products, along with a host of other products like compost tea and biochar with live beneficial bacteria).



The tour participants also spent a day in San Francisco, CA and then attended the 3<sup>rd</sup> U.S. Biochar Conference held in Sonoma, CA. Four members of the Chinese tour group presented recent research in a session specifically devoted to biochar development in China (link to: <http://2012.biochar.us.com/225/special-presentations-chinese-delegation>). The group also met with key biochar players in the U.S. (and internationally), including with Dr. Isabel Lima, a research chemist with the Agricultural Research Service at the United States Department of Agriculture (USDA). Dr. Lima is an expert in poultry litter biochar (PLB) production and testing, and has filed patents for varied uses of PLB.



Since its inception in 2006, IBI has been leading global efforts to identify and deliver the highest-priority needs of the biochar industry for successful global commercialization and impact – and this tour is a testament to IBI's role in leading the charge.

### Biochar Carbon Stability Test for Carbon Market Protocol Development: Update



Continuing our efforts towards advancing the development of biochar systems, the International Biochar Initiative is continuing work on the development of a Stable Biochar Carbon Test Methodology for the biochar offset protocol for carbon markets.

One of the most relevant characteristics of biochar is its long-term stability in soil, which is determinant for its potential as a strategy for climate change mitigation, among other benefits. IBI is leading an effort to identify a test methodology to assess and quantify the stability of carbon contained in biochar when applied to soil. This effort, called Biochar Carbon Stability Test, has the objective of developing a methodology to test for the amount of stable carbon in biochar with at least 100-year residence time in soil (with 100 years being the pro forma definition of permanence in the Kyoto Protocol, therefore applied to all carbon exchange mechanisms under its mandate, as well as to most voluntary carbon markets and carbon offset registries).

The Expert Panel that is leading this effort with IBI has now defined the basic structure and content of a methodology document, of which the core is related to the methodologies to measure the labile and stable fractions in biochar. The panel also developed a matrix summarizing 28 methodologies found in literature that may be suited to determine biochar stability.

A set of criteria to quantitatively value the methodologies found in peer-reviewed literature has also been proposed and the resulting matrix is serving to further assess these methodologies and/or some combination of them for use in the Biochar Carbon Offset Protocol.

A discussion of whether the test methodology could address possible multiple uses of biochar (i.e., beyond its use as a soil amendment) resulted in the conclusion by the Expert Panel that the

test methodology will apply solely to biochar that is used as a soil amendment, since other uses would increase complexity of the protocol and the test methodology, and most other uses have not been sufficiently well studied at this point in time.

The Expert Panel is on target to deliver a methodology to the Biochar Protocol Development Team by mid-September, as originally planned. Once the methodology is fully incorporated into the draft Protocol, and all other elements of the Protocol are concluded, IBI and its project partners that are developing the Protocol will announce a public review period, including webinars to review the draft protocol and to seek comments and answer questions.

## IBI Biochar Certification Program Announcements

Next month, IBI will be ramping up its internal testing of the IBI Biochar Certification Program tools and consumer registration webpages. This program is based on the testing requirements specified in the **International Biochar Initiative (IBI) Standardized Product Definition and Product Testing Guidelines for Biochar That Is Used in Soil** (published in May, 2012) (<http://www.biochar-international.org/characterizationstandard>).

The Biochar Certification Program and program documents will undergo a final legal review before the program is launched (launch date anticipated in October 2012). Within the next month we will post the IBI Biochar Certification Program portal on our website, which will contain all program and background materials that biochar manufacturers will need to certify their biochar through an online registration and certification process. We have also finalized and registered the Biochar Certification Program's unique seal with the US Patent and Trademark Office. Stay tuned for more information on how producers can assist us in delivering a clear, efficient process by participating in upcoming testing of the Biochar Certification Program process so that we can ensure a user-friendly, application process.



For questions or further inquiries regarding the IBI Biochar Certification Program, please contact us at [certification@biochar-international.org](mailto:certification@biochar-international.org).

## IBI Biochar Sustainability Guidelines Update

Last month, IBI announced the beginning of an international, public process to develop sustainability guidelines for biochar systems, beginning with a draft set of guiding principles for the biochar community. We would like to thank all who have contributed their excellent comments and reviews of the initial draft Sustainability Principles document. In September, we will conduct a public survey to collect input the development of the proposed Biochar Sustainability Guidelines, including the draft principles; identification of existing sustainability metrics and certifications of use to biochar systems; opinions on the most useful biochar system case studies; and identification of knowledge gaps. We will announce the survey in a special mailing in early September. In the meantime, IBI invites you to review the current documents on the IBI Sustainability Page <http://www.biochar-international.org/sustainability>. Please send your comments at any time to: [SustainableBiochar@gmail.com](mailto:SustainableBiochar@gmail.com).

IBI staff presented the draft Sustainability Principles and the overall Biochar Sustainability Guidelines process overview and timeline at the U.S. Biochar Initiative conference in California in July. The general feedback from the conference attendees was that biochar sustainability guidelines are very much needed, and many businesses are already engaged in establishing sustainable practices and seeking sustainability certification for their biomass feedstocks, in particular. Sharing the panel with IBI was John Miedema of Pacific Northwest Biochar and

Thompson Timber. Mr. Miedema led a team at the U.S. Biochar Initiative to draft a set of protocols for a sustainable U.S. biochar industry. He is also one of the first biochar producers to conduct a Life Cycle Analysis (LCA) of his production system. You can read more about Mr. Miedema in this profile of his company and his work [http://www.biochar-international.org/profiles/Thompson\\_Timber](http://www.biochar-international.org/profiles/Thompson_Timber). The USBI Biochar Sustainability Protocols ([www.biochar-international.org/sites/default/files/Biochar\\_Sustainability\\_Protocols\\_March\\_2011\\_Draft.pdf](http://www.biochar-international.org/sites/default/files/Biochar_Sustainability_Protocols_March_2011_Draft.pdf)) are an example of the kind of work that IBI hopes to draw upon to produce comprehensive, internationally applicable Biochar Sustainability Guidelines.

## U.S. Biochar Conference a Great Success



Building on the tradition of successful U.S.-based biochar conferences, the 2012 U.S. Biochar Conference delivered four full days of networking, presentations, updates and announcements, accompanied by delicious local wine and food. Hosted by the Sonoma Biochar Initiative from July 29 – August 1, 2012 at Sonoma State University in Rohnert Park, CA, the event attracted 370 registrants; including 104 presenters from 14 countries (the presentations are available at: <http://2012.biochar.us.com/299/2012-us-biochar-conference-presentations>; plenary session video is available at: <http://sonomabiocharinitiative.org>). Mr. Ray Gallian, one of the founding members of the Sonoma Biochar Initiative opened the event (<http://2012.biochar.us.com/356/conference-opening-remarks-ray-gallian>) with a speech highlighting the role biochar should play in the world as “one big tool in a toolbox of survival responses” to climate change. The conference was designed to showcase the many facets of biochar—from production, use in soils, characterization, sustainability and carbon sequestration to policy, finance, and economics. In an effort to also highlight the role of California’s agricultural heritage and to get participants out into the field, the conference hosted a number of farm tour sessions to give participants the opportunity visit farms and speak with farmers and others working in agriculture.

Moving from a local view to an international view, the conference included a session focusing on biochar developments in China with four presentations from the IBI-hosted Chinese delegation, who had just completed a tour of biochar –related sites in the U.S. These presentations highlighted the national plans in China to utilize crop wastes for biochar production (as well as for fertilizer, food, and fuel), the developments in biochar production systems in China, and a number of pot and field trials performed utilizing different types of biochars and crops. In addition to the 14-person Chinese delegation, attendees traveled from Canada, Brazil, Germany, the U.K., Australia, Nigeria, and Kenya among other countries to highlight their research, companies and projects.

IBI staff, in multiple presentations, highlighted the overall growth of the biochar movement and IBI’s role in meeting ongoing challenges ([http://www.biochar-international.org/sites/default/files/Thayer\\_Tomlinson\\_USBI\\_2012\\_IBI\\_Overview\\_final.pdf](http://www.biochar-international.org/sites/default/files/Thayer_Tomlinson_USBI_2012_IBI_Overview_final.pdf)) and IBI’s International Sustainability Guidelines Effort ([http://www.biochar-international.org/sites/default/files/USBI\\_Conf\\_IBI\\_sustainable\\_biochar\\_7.31.12.pdf](http://www.biochar-international.org/sites/default/files/USBI_Conf_IBI_sustainable_biochar_7.31.12.pdf)). Additionally,

IBI Board Chair Dr. Johannes Lehmann presented new research on biochar and its role in carbon sequestration and there was a presentation on the Biochar Carbon Protocol

([http://2012.biochar.us.com/sites/2012.biochar.us.com/files/presentations/Blue%20Moon%20Fund%20Biochar%20Protocol%20US%20Biochar%202012%20Conference%20Presentation\\_0.pdf](http://2012.biochar.us.com/sites/2012.biochar.us.com/files/presentations/Blue%20Moon%20Fund%20Biochar%20Protocol%20US%20Biochar%202012%20Conference%20Presentation_0.pdf)).

Photos of the event can be found here (link to: [http://melania.smugmug.com/Events/Biochar-Conference-SSU/24703680\\_mShcmL#!i=2020044168&k=jQPczfJ/](http://melania.smugmug.com/Events/Biochar-Conference-SSU/24703680_mShcmL#!i=2020044168&k=jQPczfJ/)). The conference organizers also announced that the next U.S. Biochar Conference will be held in October 2013 in Amherst MA.

## Biochar Briefs: News Roundup for August

We update the website daily with new articles on biochar. For more information, please see: <http://www.biochar-international.org/newsbriefs>.

### **Australia**

<http://www.abc.net.au/rural/tas/content/2012/08/s3569354.htm?site=northtas>

In northern Victoria, the North East Catchment Management Authority has funded a portable biochar machine, to turn invasive willow wood into biochar for local farms.

### **Brazil**

<http://chicoterra.com/2012/07/16/embrapa-amapa-pesquisa-residuos-de-castanha-do-brasil-para-producao-de-carvao/>

Embrapa Amapa, a unit of the Brazilian Agricultural Research Corporation (Embrapa), is carrying out research on Brazil nut shell biochar. The two-year project, begun in May 2012, will look at appropriate carbonization technologies and evaluate the potential of biochar both for energy use and to improve soil fertility.

### **China**

<http://news.hexun.com/2012-08-10/144632337.html?from=rss>

At the Aesthetics and Sustainability Exhibition in Beijing, artist Matsuzaka Asia demonstrates making fertilizer from biochar and kitchen waste. She created a microbial fermentation mix from bacteria collected from China, Japan, and South Korea.

### **Germany**

<http://www.wiesentbote.de/2012/08/03/terra-preta-versuch-am-lehrgut-des-bezirks-oberfranken/>

Agronomist Daniel Fischer of the Martin Luther University Halle-Wittenberg is seeing good results after two years of biochar field trials with grain crops in the Upper Franconia region of Bavaria.

<http://www.investor-verlag.de/terra-preta-der-wertvolle-humus-der-amazonas-ureinwohner/109139092/>

Scientists at the Berlin Botanic Garden are designing a system to make biochar from the garden's greenwaste and combine it with human waste generated by visitors to produce all the fertilizer and compost needed for the garden.

### **Kenya**

<http://www.greatenergychallengeblog.com/2012/08/21/fueling-agricultural-change-in-western-kenya>

Salim Shaban of ACON highlights his work with biochar producing stoves in Western Kenya using water hyacinth in a National Geographic funded project. More information on IBI's role in this project can be found at: [http://www.biochar-international.org/National\\_Geographic](http://www.biochar-international.org/National_Geographic).

## **New Zealand**

<http://www.waste-management-world.com/index/from-the-wires/wire-news-display/1728621551.html>

A recap of biochar research at Massey University describes the directions research has taken over the years, exploring the economics of biochar made from wood or sewage, and the effects in different soil types.

## **Philippines**

<http://businessmirror.com.ph/home/regions/31648-sustainable-farmer-uses-humanure-to-close-loop-between-food-production-and-sanitation>

The Water, Agroforestry, Nutrition and Development (WAND) Foundation is supporting work in the Philippines to convert human waste from dehydrating toilets into fertilizer using lacto-bacilli, biochar, African night crawler worms, and other organic matter.

## **United Kingdom**

[http://www.labmate-online.com/news/news-and-views/5/university\\_of\\_swansea/can\\_charcoal\\_help\\_fight\\_climate\\_change/21477/](http://www.labmate-online.com/news/news-and-views/5/university_of_swansea/can_charcoal_help_fight_climate_change/21477/)

The Welsh Livery Guild has awarded a travel scholarship of £1000 to PhD research student Ian Mugford to allow him to carry out fieldwork on biochar in Italy.

<http://www.egovmonitor.com/node/52324>

The European Bioenergy Research Institute (EBRI) at Aston University in Wales, UK outlines a vision for sustainable, distributed bioenergy from waste biomass using its Pyroformer technology, with biochar as a byproduct.

<http://www.fwi.co.uk/Articles/27/07/2012/134157/Green-Energy-Farmer->

Green Energy Farmer of the Year finalist Tim Barton grows miscanthus for energy and biochar on his Wiltshire farm.

<http://www.green-energy-news.com/nwslnks/clips812/aug12016.html>

ZeroPoint Clean Tech, Inc. (ZeroPoint) has announced that its second biomass gasification deployment in Newry, Ireland is producing heat, power, and biochar.

## **United States**

[http://www.flatheadnewsgroup.com/whitefishpilot/article\\_b492e2c8-ec74-11e1-9fd2-0019bb2963f4.html](http://www.flatheadnewsgroup.com/whitefishpilot/article_b492e2c8-ec74-11e1-9fd2-0019bb2963f4.html)

The Algae Aqua-Culture Technology Green Power House in Whitefish, Montana held its first public open house. The bio-refinery produces biochar and power using wood waste and algae. Initial funding was provided by a \$350,000 grant from the Montana Department of Environmental Quality.

[http://blogs.westword.com/latestword/2012/08/toilet\\_cu\\_boulder.php](http://blogs.westword.com/latestword/2012/08/toilet_cu_boulder.php)

Researchers at Colorado University, Boulder have won a nearly \$780,000 "Reinvent the Toilet" grant from the Gates Foundation to develop their design that uses solar power and biochar to sanitize human waste for return to the soil.

<http://www.sonomanews.com/News-2012/Biochar-draws-scientists-worldwide/>

The recent U.S. Biochar conference drew scientists from around the world, including Joy Ubah, a Nigerian Ph.D. candidate, who came all the way from Africa to learn about low cost pyrolysis units for making biochar that she hopes will help restore soils in her country and combat hunger.

<http://biomassmagazine.com/articles/7920/ore-working-group-outlines-strategy-to-improve-biomass-industry>

The Oregon Forest Biomass Working Group has issued a forest biomass strategy, which includes four key initiatives, including the need to commercialize and develop biomass thermal energy and biochar.

## New Pyrolysis Reports Released from Washington State University

The Center for Sustaining Agriculture and Natural Resources (CSANR) at Washington State University, through a contract with the Washington Department of Ecology (Ecology) has released the second and third in a series of four reports that review the literature on pyrolysis and biochar production. The second report of the series is a *Literature Review of the Biomass Supply Chain and Preprocessing Technologies, From Field to Pyrolysis Reactor*. This report reviews collection, handling and pretreatment methods for biomass sources from waste, agriculture and forests. It can be found at: <http://www.ecy.wa.gov/biblio/1207033.html>. The third report is a *Literature Review of Technologies for Product Collection and Refining*. The report describes technologies and methods for bio-oil product recovery and characterization, biochar activation, bio-oil refining strategies and regulatory issues related with deployment of pyrolysis technologies. It can be found at: <http://www.ecy.wa.gov/biblio/1207034.html>. A final fourth report on sustainable business models for biochar enterprises is in preparation, and will be made available upon completion. Information on the program and the previous reports can be found at <http://www.biochar-international.org/biocharwashingtonstate>.

## Opportunities in Biochar

- Registration now open: The 2<sup>nd</sup> Nordic Biochar Seminar (February 14 – 15, 2013 in Helsinki, Finland); for more information see: <http://www.njf.nu/site/seminarRedirect.asp?intSeminarID=459&p=1004>.
- Submit Abstract: 1st Mediterranean Biochar Symposium in Italy (January 2013): Call for abstracts (due Oct. 20th); see: <http://www.biochar-international.org/node/3602>.
- Apply for a Grant: The US Department of Agriculture's Natural Resources Conservation Service (NRCS) announces grants to help farmers and ranchers adapt to drought with \$5 million in Conservation Innovation Grants available for development of novel agricultural practices. NRCS is offering the grants to partnering entities to evaluate innovative, field-based conservation technologies and approaches. These technologies and/or approaches should lead to improvements such as enhancing the water-holding capacity in soils. **The deadline to apply for funding is October 15, 2012.** For more information see: <http://www.biochar-international.org/node/3558>
- Apply for a Grant: The US Department of Agriculture Rural Development is allocating up to \$14 million in grants available for projects that help farmers produce bio-based products from agricultural commodities. The Value-Added Producer Grants program is designed to help agricultural producers enter into value-added activities. Awards may be made for either economic planning or working capital activities related to the processing and/or marketing of valued-added agricultural products. The maximum grant amount for a planning grant is \$100,000 and the maximum grant amount for a working capital grant is \$300,000. **The deadline to apply for funding is October 15, 2012.** For more information see: <http://www.biochar-international.org/node/3583>.

## Upcoming Calendar Events

- August 31 – September 4: CHAB Camp (Combined Heat and Biochar); location Summertown, TN, United States; more information: <http://www.biochar-international.org/node/3224>.
- September 9 – 16: 1<sup>st</sup> International Summer School on Biochar; location Potsdam, Germany; more information: <http://www.biochar-international.org/node/3179>.

- September 10 – 15: International Training Course on Biochar Production, Testing and Utilisation; location Nanjing, China; more information: <http://www.biochar-international.org/node/3239>.
- September 16 – 20: 4<sup>th</sup> International Biochar Congress; Biochar: The Road to Richer Food and a Safer Environment; location Beijing, China; more information: <http://www.ibi2012.org>.
- September 19: Talk on Biochar to Master Gardeners; location Volusia County, FL, US; more information: <http://www.biochar-international.org/node/3390>.
- October 10 – 11: Biogas USA West; location San Francisco, CA, USA; more information: <http://www.biochar-international.org/node/3301>.
- October 17 – 19: RETECH 2012; location: Washington DC, USA; more information: <http://www.biochar-international.org/node/3083>.

See the [IBI Calendar page](#) for more events. To add an event to the calendar, send the information to [info@biochar-international.org](mailto:info@biochar-international.org).

## Recently Published Biochar Research

IBI tracks all published research on biochar and includes it in our [online bibliography](#). The following articles were added in the last month. Please visit the website bibliography for more information on any of these articles. Due to copyright, we cannot provide full copies of articles unless we have permission from the publisher. If you have published work that is not included, [please email us](#).

Cheng, Hongguang; Xinqing Lee; Like Zhang; Bin Fang; Fang Yang (2012). The Deviation on the Determination of Microbial Biomass Carbon in Biochar Amendment Soil with Fumigation Extraction. *Journal of Agricultural Science*. Vol. 4, No 9.

Deveci, Hüseyin; Yakup Kar (2012). Adsorption of hexavalent chromium from aqueous solutions by bio-chars obtained during biomass pyrolysis. *Journal of Industrial and Engineering Chemistry*.

Dou, Lei; Masakazu Komatsuzaki; and Mitsuhiro Nakagawa (2012). Effects of Biochar, Mokusakueki and Bokashi application on soil nutrients, yields and qualities of sweet potato. *International Research Journal of Agricultural Science and Soil Science*. Vol. 2(8) pp. 318-327. <http://interesjournals.org/IRJAS/Pdf/2012/August/Dou%20et%20al.pdf>.

T. Echterhof, H. Pfeifer (2012). Study on biochar usage in the electric arc furnace. [http://www.researchgate.net/publication/215714915\\_Study\\_on\\_biochar\\_usage\\_in\\_the\\_electric\\_arc\\_furnace](http://www.researchgate.net/publication/215714915_Study_on_biochar_usage_in_the_electric_arc_furnace).

Fischer, Daniel; Bruno Glaser (2012). Synergisms between Compost and Biochar for Sustainable Soil Amelioration. *Management of Organic Waste*. DOI: 10.5772/31200. <http://www.intechopen.com/books/management-of-organic-waste/synergism-between-biochar-and-compost-for-sustainable-soil-amelioration>.

Freddo, Alessia; Chao Cai; Brian J. Reid (2012). Environmental contextualisation of potential toxic elements and polycyclic aromatic hydrocarbons in biochar. *Environmental Pollution*. Volume 171. Pages 18–24.



Güereña, David; Johannes Lehmann; Kelly Hanley; Akio Enders; Charles Hyland; and Susan Riha (2012). Nitrogen dynamics following field application of biochar in a temperate North American maize-based production system. *Plant and Soil*. DOI: 10.1007/s11104-012-1383-4.

Keiluweit, Marco; Markus Kleber; Margaret A Sparrow; Bernd R.T. Simoneit; and Fredrick G. Pahl (2012). Solvent-extractable Polycyclic Aromatic Hydrocarbons in Biochar: Influence of Pyrolysis Temperature and Feedstock. *Environ. Sci. Technol.* DOI: 10.1021/es302125k.

Koehler, Steffen D.; Ed Gerhardt; Stephen Joseph (2012). Improving Yields of Strawberries Grown in South Florida Through Addition of Compost Biochar and Minerals. [http://www.biochar-international.org/sites/default/files/Biochar\\_Strawberry\\_Trial%20writeup\\_clean-1.pdf](http://www.biochar-international.org/sites/default/files/Biochar_Strawberry_Trial%20writeup_clean-1.pdf)

Li, L.; Liu, Y.; Pan, W.; Pan, G.; Zheng, J.; Zheng, J.; Zhang, X. (2012). Effects of Amendment of Biochar and Pyrolytic Solution from wheat straw pyrolysis on Yield and soil and crop salinity in a Salt stressed cropland from Central China Great Plain. EGU General Assembly 2012, held 22-27 April, 2012 in Vienna, Austria., p.13770.

Liu, Zhengang; Augustine Quek; S. Kent Hoekman; R. Balasubramanian (2012). Production of solid biochar fuel from waste biomass by hydrothermal carbonization. *Fuel*.

Quilliam, Richard S.; Thomas H. DeLuca; and Davey L. Jones (2012). Biochar application reduces nodulation but increases nitrogenase activity in clover. *Plant and Soil*. DOI: 10.1007/s11104-012-1411-4.

Remenárová, Lucia; Martin Pipiska; Miroslav Horník; Marián Rozložník; Jozef Augustín; Gerhard Soja (2012). Cadmium and Zinc Sorption from Single and Binary Solutions by Straw Biochar: The Role of Functional Groups. Biosorption and bioaccumulation of heavy metals. [http://biobio.vscht.cz/files/Book\\_of\\_proceedings.pdf#page=28](http://biobio.vscht.cz/files/Book_of_proceedings.pdf#page=28).

Shafie, Siti Thaiyiba; Mohamad Amran Mohd Salleh; Lau Lek Hang; Md. Mukhlesur Rahman; Wan Azlina Wan; Abdul Karim Ghani (2012). Effect of pyrolysis temperature on the biochar nutrient and water retention capacity. *Journal of Purity, Utility Reaction and Environment* Vol. 1 No. 6, 293-307.

Wang, Kaige; Robert C. Brown; Sally Homsy; Liliana Martinez; Sukh S. Sidhu (2012). Fast pyrolysis of microalgae remnants in a fluidized bed reactor for bio-oil and biochar production. *Bioresource Technology*.

Wang, Tao; Marta Camps Arbestain; Mike Hedley; Peter Bishop (2012). Chemical and bioassay characterisation of nitrogen availability in biochar produced from dairy manure and biosolids. *Organic Geochemistry*.

Xu, Gang; Yingchun Lv; Junna Sun; Hongbo Shao; and Linlin Wei (2012). Recent Advances in Biochar Applications in Agricultural Soils: Benefits and Environmental Implications. *CLEAN – Soil, Air, Water*. DOI: 10.1002/clen.201100738. <http://onlinelibrary.wiley.com/doi/10.1002/clen.201100738/full>.

Zhang, Zhi-bin, Xiao-hong Cao, Ping Liang, Yun-hai Liu (2012). Adsorption of uranium from aqueous solution using biochar produced by hydrothermal carbonization. *Journal of Radioanalytical and Nuclear Chemistry*.

Zimmermann, Michael; Michael I. Bird; Christopher Wurster; Gustavo Saiz; Iain Goodrick; Jiri Barta; Petr Capek; Hana Santruckova; Ronald Smernik (2012). Rapid degradation of pyrogenic carbon. *Global Change Biology*. DOI: 10.1111/j.1365-2486.2012.02796.x.