

I'm not robot!

Published on: September 30, 2016 Sequestering Carbon in the Soil Using Biochar Soils store three times more carbon than exists in the atmosphere. Plants absorb atmospheric carbon during photosynthesis, so the return of plant residues into the soil contributing to soil carbon. While much of this carbon ultimately returns to the atmosphere as soil microbes decompose carbon based plant biomass and release carbon dioxide, soil carbon stores can increase if the rate of carbon inputs exceeds the rate of microbial decomposition. Carbon sequestration refers to this process of storing carbon in soil organic matter and thus removing carbon dioxide from the atmosphere. Biochar is produced from burning organic material at high temperatures with little to no oxygen availability. The potential of utilizing biochar to sequester carbon in the soil has received considerable research attention in recent years as part of efforts to develop climate smart agricultural practices. As the majority of biochar is carbon (70-80%) it can potentially contribute more carbon than plant residue (approximately 40% carbon) of similar mass. Furthermore, around 60% of this biochar organic carbon is of high stability and therefore resists decomposition more-so than plant material that has not been processed into biochar. That being said, many questions remain as to the effectiveness of biochar application in sequestering carbon. (For more information about biochar, check out our recent blog post) Persistence of Biochar Carbon in Soil While biochar does contain high levels of carbon, there remains uncertainty as to how long that carbon will persist in the soil following application. The inherent characteristics of the biochar--as dictated by feedstock and pyrolysis conditions--interact with climatic conditions such as precipitation and temperature to influence how long biochar carbon remains stored in the soil. Recent studies suggest that shorter pyrolysis times and higher pyrolysis temperatures make for more recalcitrant biochar (i.e. it persists for longer periods in the soil). However, there are trade-offs involved as these pyrolysis conditions produce less biochar per unit feedstock. As is so often the case, soil texture plays a key role in determining the persistence of biochar carbon. Biochar becomes stabilized in the soil by interacting with soil particles. Clay particles have more surface area for biochar to interact with and are therefore more effective at stabilizing biochar. The Priming Effect A number of studies have observed an increase in the rate of organic matter decomposition following biochar application. This so-called "priming effect" complicates any efforts to sequester carbon as this increase in microbial activity could result in decomposition rates exceeding carbon input rates (see figure above). While the exact mechanism responsible for this effect has not been conclusively identified, it may result from the stimulation of microbial activity as microbes utilize carbon and nitrogen present in biochar. Biochar remains a hot topic with regards to increasing soil carbon stores and helping fight climate change. However, many questions remain before definitive conclusions about what conditions allow for biochar to positively contribute to soil carbon sequestration. Sources Ontl, T. A. & Schulte, L. A. (2012) Soil Carbon Storage. *Nature Education Knowledge* 3(10):35 Lal, R. (2016). Biochar and Soil Carbon Sequestration. *Agricultural and Environmental Applications of Biochar: Advances and Barriers*. M. Guo, Z. He and S. M. Uchimiya. Madison, WI. Soil Science Society of America, Inc., 175-198. Stewart, C. E., et al. (2013). "Co-generated fast pyrolysis biochar mitigates green-house gas emissions and increases carbon sequestration in temperate soils." *GCB Bioenergy* 5(2): 153-164. Yang, F., et al. (2016). "The Interfacial Behavior between Biochar and Soil Minerals and Its Effect on Biochar Stability." *Environmental Science & Technology* 50(5): 2264-2271. Potassium doping increases biochar carbon sequestration potential by 45%, facilitating decoupling of carbon sequestration from soil improvement Negative emissions technologies offer an important tool to limit the global warming to

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