Pacific Biochar

Josiah Hunt, CEO
808-936-3484
josiah@pacificbiochar.com

Michael Fallon, CFO
805-252-8553
michael@pacificbiochar.com

AGRICULTURAL BENEFITS OF BIOCHAR

Biochar is simply defined as a biomass charcoal when used or found in soil. For as long as fire and plant life have co-existed, pyrogenic organic matter (biochar) has played a role in the development and fertility of topsoil. Biochar is effective in retaining water and nutrients in the root zone where it is available to plants, increasing soil tilth, and supporting microbial communities. Biochar is highly recalcitrant, it does not easily decay, and thus has the ability to sequester organic carbon for millennia—a benefit to soil fertility and a benefit to humanity in helping to reduce atmospheric carbon.

WATER CONSERVATION

Where biochar has been applied, soils show higher water-holding capacity, improved water retention, increased plant-available water, increased plant resilience in drought conditions, and greater crop productivity per unit of water. The crop yield benefits of adding biochar to agricultural practices can be seen in different ways:

- Under highly managed irrigation, an expected outcome would be reduction in amount of water needed.
- In systems that are limited in control, an expected outcome would be mitigating undesired crop stress.[1]

NUTRIENT CONSERVATION

Plant nutrients are lost to groundwater through leaching and lost to the air through volatilization. This poses a loss of efficiency on the farm and an environmental problem beyond the fence. The United States Environmental Protection Agency (US EPA) has been quoted as saying: "Nutrient pollution is one of America's most widespread, costly and challenging environmental problems, and is caused by excess nitrogen and phosphorus in the air and water."

Fertilizer efficiency has been notably improved after the application of biochar. This has been primarily observed as a reduction in the loss of plant nutrients. Analogous to the use of charcoal in filtration, biochar (a type of charcoal) can help hold onto plant nutrients in the topsoil. However, it is important to note that the majority of nutrients held by the biochar are still plant available—resistant to loss, yet still available for use.[2]

MICROBIAL COMMUNITY SUPPORT

The anatomical structure of the plant material used to make biochar—the vascular tissue of tubes and tunnels that were used to carry food and water throughout the plant body—remains largely intact during and after the production process of firing. The resulting biochar material is intricately structured, porous,

---

[1] C. Kammann et al, 2011. Influence of biochar on drought tolerance of Chenopodium quinoa Willd and on soil-plant relations. Plant and Soil. 345:195-210, August 2011

Lorenzo Genesio et al., 2015. Biochar increases vineyard productivity without affecting grape quality: Results from a four years field experiment in Tuscany. Agriculture, Ecosystems, and Environment 201 (2015) 20-25

[2] Glaser, Bruno et al., 2015 Biochar organic fertilizers from natural resources as substitute for mineral fertilizers. Agronomy for Sustainable Development (2015) 35:667–678

Singh, Bhupinder Pal et al., 2013. Influence of Biochars on Nitrous Oxide Emission and Nitrogen Leaching from Two Contrasting Soils J. Environ. Qual. 39:1224–1235 (2010) doi:10.2134/jeq2009.0138

P.A. Trazzi et al., 2016. Adsorption and desorption of phosphate on biochars Journal of Environmental Chemical Engineering, Volume 4, Issue 1, March 2016, Pages 37–46 resistant to decay, and carbon based, characteristics well suited to supporting microbial life. When biochar is used in soil, microbial communities are observed to be more diverse, active, and are found to fare better through adversity.[3]

STABLE ORGANIC MATTER

Organic matter is critical for soil function and soil quality. Charcoal (biochar) is a stable form of soil organic matter. It is naturally occurring and has been found to make up as much as 30% of the organic matter in soils such as the dark fertile soils of Iowa, and of the famously fertile manmade soils in the Amazon region called Terra Preta.

Using biochar provides a method of increasing soil organic matter in a way that is stable for centuries. The exact long-term stability of a given biochar can be estimated with a fairly simple analytical test that measures the hydrogen to organic carbon ratio (H:Corg). This method has been acknowledged by the California Air Pollution Control Officers Association (CAPCOA) as acceptable for measuring greenhouse gas emissions reductions. The biochar that is manufactured and distributed by Pacific Biochar has H:Corg ratio of 0.32, which implies relatively high stability. For a biochar such as ours, with an H:Corg below 0.4, it is estimated that greater than 90% of the original carbon will remain intact after 100 years (to be conservative, a lower rate of 70% is used for carbon accounting). This has important implications for long-term soil fertility and also for safely sequestering carbon.[4]

---

[3] Cayuela, M.L. et al., 2013. Biochar and denitrification in soils: when, how much and why does biochar reduce N2O emissions? Sci. Rep. 3, 1732; DOI:10.1038/ srep01732 (2013).

Liang, Chenfei et al., 2014 Biochar alters the resistance and resilience to drought in a tropical soil Environmental Research Letters 9 (2014) 064013 (6pp)

B. O'Niell et al. 2011. Bacterial Community Composition in Brazilian Anthrosols and Adjacent Soils Characterized Using Culturing and Molecular Identification Microb Ecol (2009) 58:23–35

[4] Heike Knicker (2011). Pyrogenic organic matter in soil: Its origin and occurrence, its chemistry and survival in soil environments. Quaternary International 243(2):251-263 · October 2011.

A. Budai et al., 2013. Biochar Carbon Stability Test Method: An assessment of methods to determine biochar carbon stability. International Biochar Initiative. September 20, 2013

CAPCOA GHG Rx Protocol: Biochar Production Project Reporting Protocol, GHG Emission Reduction Accounting (Approved by CAPCOA Board September 28, 2105)

CAPCOA GHG Rx Protocol Addendum: To the Biochar Production Project Reporting Protocol, GHG Emission Reduction Accounting, June 14, 2016 (Approved by the CAPCOA Board on August 31, 2016)