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Biochar – A Valuable Soil Amendment

P. Christy Nirmala Mary^{1*}, R. Murugaragavan¹, J. Ramachandran², R. Shanmugasundaram¹ and S. Karpagam¹

¹Dept. of Soils and Environment, ²Dept. of Agricultural Engineering, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Madurai, Tamil Nadu (625 104), India



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Corresponding Author

P. Christy Nirmala Mary
e-mail: chrismary@rediffmail.com

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E-mail: bioticapublications@gmail.com

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Abstract

Biochar is charred organic matter intended for use as a soil amendment. Biochar is produced by a thermochemical decomposition process called pyrolysis, which consists of heating biomass at a high temperature ($\gg 400-8000^\circ\text{C}$) in a limited oxygen environment. Biochar can be an important tool to increase food security and cropland diversity in areas with severely depleted soils, scarce organic resources, and inadequate water and chemical fertilizer supplies. Biochar also improves water quality and quantity by increasing soil retention of nutrients and agrochemicals for plant and crop utilization. Biochar helps to reclaim degraded soils. The water retention capacity of the biochar compost makes it ideal for conservation and the use of the scarce water. Biochar helps to prevent fertilizer runoff and leaching, allowing the use of less fertilizer and diminishing agricultural pollution to the surrounding environment.

Introduction

Biochar is charred organic matter intended for use as a soil amendment. Biochar is produced by a thermochemical decomposition process called pyrolysis, which consists of heating biomass at a high temperature ($\gg 400-8000^\circ\text{C}$) in a limited oxygen environment. Biochar is a porous carbonaceous solid produced by thermo-chemical conversion of organic materials in an oxygen depleted atmosphere which has physiochemical properties suitable for the safe and long-term storage of carbon in the environment and, potentially soil improvement. Biochar is distinguished from charcoal by its intended use to both improve soil properties and sequester soil carbon. The pyrolysis of biomass results in biochar as well as gas and liquid products in varying proportions depending on the type of organic material and heating temperature.

Biochar

The term biochar is relatively new and has recently garnered significant interest, but the use of charcoal in soils is not a new practice. This sustained fertility and carbon content has been attributed to the accumulation of charcoal in the soil over time. Charcoal is present in many soils around the world as a result of both anthropogenic and natural causes. This 2,000 year-old practice converts agricultural waste into a soil enhancer that can hold carbon, boost food security, and increase soil biodiversity, and discourage deforestation. The process creates a fine-grained, highly porous charcoal that helps soils retain nutrients and water.

Biochar is defined simply as charcoal that is used for agricultural purposes. It is created using a pyrolysis process, heating biomass in a low oxygen environment. Once the pyrolysis reaction has begun, it is self-sustaining, requiring no outside energy input. By products of the process include syngas ($\text{H}_2 + \text{CO}$), minor quantities of methane (CH_4), tars,

organic acids and excess heat. Biochar is produced through pyrolysis or gasification processes that heat biomass in the absence (or under reduction) of oxygen.

Biochar can be an important tool to increase food security and cropland diversity in areas with severely depleted soils, scarce organic resources, and inadequate water and chemical fertilizer supplies. Biochar also improves water quality and quantity by increasing soil retention of nutrients and agrochemicals for plant and crop utilization. More nutrients stay in the soil instead of leaching into groundwater and causing pollution. The carbon in biochar resists degradation and can hold carbon in soils for hundreds to thousands of years.

In addition to creating a soil enhancer, sustainable biochar practices can produce oil and gas by products that can be used as fuel, providing clean, renewable energy. When the biochar is buried in the ground as a soil enhancer, the system can become “carbon negative”. Biochar and bio-energy coproduction can help combat global climate change by displacing fossil fuel use and by sequestering carbon in stable soil carbon pools. It may also reduce emissions of nitrous oxide. Once it is produced, biochar is spread on agricultural fields and incorporated into the top layer of soil. Biochar has many agricultural benefits. It increases crop yields, sometimes substantially if the soil is in poor condition. It helps to prevent fertilizer runoff and leaching, allowing the use of less fertilizers and diminishing agricultural pollution to the surrounding environment. And it retains moisture, helping plants through periods of drought more easily. Most importantly, it replenishes exhausted or marginal soils with organic carbon and fosters the growth of soil microbes essential for nutrient absorption, particularly mycorrhizal fungi.

Biochar Properties

Biochar is a light weight, highly porous material with high carbon content, a portion of which has a stable chemical structure resistant to decay. Biochar is typically low in available nutrients, though contains some ash content, which adds some nutrients, and typically has an alkaline pH. Though different biochars share these basic characteristics, all biochars have different specific characteristics depending on the properties of the starting organic material (feedstock) and the pyrolysis parameters used for production. For instance a wood derived biochar will contain a higher proportion of carbon than a manure biochar due to starting differences in carbon content. In turn a manure biochar will contain more ashes than wood biochar due to higher nutrient content in manure.

Soil Benefits and Crop Productivity

Biochar has both short-term and long-term effects on soil. The low ash content in some biochars can provide short-term benefits by contributing nutrients and offering a

liming effect for soils where the pH is lower than optimum. The long lasting benefits of biochar include the soil's increased retention of nutrients and water, which enhances crop growth. Less leaching of nutrients (such as calcium, potassium, magnesium, and nitrogen) means that more nutrients are available for plant uptake. Therefore adding biochar to soil will result in greater fertilizer efficiency; the crop can use a greater amount of the fertilizer added. Although biochar is not a fertilizer itself, it improves the overall health and quality of the soil. Biochar can be used in all types of agricultural systems (organic, chemical, permaculture, mixed farming, natural farming, biodynamic agriculture, home therapy for agriculture, zero tillage farming, etc. Biochar helps to reclaim degraded soils. The water retention capacity of the biochar compost makes it ideal for conservation and the use of the scarce water. Biochar helps to prevent fertilizer runoff and leaching, allowing the use of less fertilizer and diminishing agricultural pollution to the surrounding environment. Biochar is applicable for human and animal waste management, converting urine, excrement, or dung into fertilizers and resulting in emissions reduction. Biochar protects and supports the growth of roots. It increases the available nutrients for plant growth, resulting in yield increases. Biochar increases soil biodiversity and soil-life density. The water retention capacity of the biochar compost makes it ideal for conservation and the use of the scarce water. Biochar gardens present low-cost solutions for efficient use of urban spaces. “Biochar improves soil quality through its effects on key soil processes. Many of the benefits of biochar derive from its highly porous structure and associated high surface area. Charges on the high surface area can increase cation exchange capacity (CEC) thereby increasing a soil's ability to retain and supply nutrients. Increased porosity can increase soil water holding capacity and the small pore spaces with positively charge surfaces can improve soil water retention and in turn reduce nutrient loss through leaching.

Conclusion

Biochar helps to reclaim degraded soils. The water retention capacity of the biochar compost makes it ideal for conservation and the use of the scarce water. Biochar helps to prevent fertilizer runoff and leaching, allowing the use of less fertilizer and diminishing agricultural pollution to the surrounding environment. Biochar is applicable for human and animal waste management, converting urine, excrement, or dung into fertilizers and resulting in emissions reduction. Biochar protects and supports the growth of roots. It increases the available nutrients for plant growth, resulting in yield increases. Biochar increases soil biodiversity and soil-life density. The water retention capacity of the biochar compost makes it ideal for conservation and the use of the scarce water. Biochar gardens present low-cost solutions for efficient use of urban spaces. “Biochar improves soil quality through its effects on key soil processes.

References

- Chan, Y., Van Zwieten, L., Meszaros, I., Downie, A., Joseph, S., 2008. Using poultry litter biochars as soil amendments. *Australian Journal of Soil Research*, 46: 437-444.
- Glaser, B., Lehmann, J., Zech, W., 2002. Ameliorating physical and chemical properties of highly weathered soils in the tropics with charcoal – a review. *Biology and Fertility Soils*, 35: 219-230.
- Murugaragavan Ramasamy, Saravanakumar Subbaiya and Rakesh Subramanian Srirangarayan, 2020. Biochar from crop residues and its impact on soil quality and carbon sequestration. LAP LAMBERT Academic Publishing, Mauritius. Pp:1-80.