Ecofarming
e-Magazine for Agriculture and Allied Sciences
http://www.rdagriculture.in
e-ISSN: 2583-0791
Ecofarming Vol. 02(03): 140-142, 2022

Biochar

Qualitative Soil Amendment

Vishal Singh, Robin Kumar[1], Kuldeep Singh

Department of Agronomy
ANDUA&T, Kumarganj, Ayodhya

[1]Department of soil Science and Agricultural Chemistry
ANDUA&T, Kumarganj, Ayodhya

Received: **April 12, 2022;** ***Revised:*** **April 17, 2022** ***Accepted:*** **April 20, 2022**

Introduction

The term "biochar" refers to the black carbon produced by the gradual pyrolysis of biomass in a low-oxygen environment that prevents it from totally combusting. Biochar made from woody biomass is commonly referred to as charcoal. "The

solid material generated from the thermochemical conversion of biomass in an oxygen-limited environment," according to the International Biochar Initiative. It is recognised as charcoal, which is prevalent in soil, aquatic ecosystems, and animal digestive systems and participates in biological processes. Biochar is produced through pyrogenic carbon capture and storage techniques. Biochar has been a focus point in the twenty-first century due to its unique qualities, wide applicability, and strong development prospects. Charring is another type of biochar, which involves partially burning the surface to blacken it. Charring is a chemical reaction that occurs when some solids are exposed to intense heat and undergo incomplete combustion. Water vapour and volatile organic chemicals (syngas) are removed from the matrix by heat distillation. Char is the black carbon substance that remains. This partially burned product could serve as a significant long-term carbon sink.

Properties of Biochar

- Properties are classified according to their proximate and elemental compositions, pH value, and porosity.
- Biochar's atomic ratios, such as H/C and O/C, are related to qualities related to organic content, such as polarity and aromaticity.
- As functional groups containing hydrogen and oxygen are released during the carbonization process, both the H/C and O/C ratios fall.
- The physical structure of biochar is frequently described using scanning electron microscopy (SEM). The macroporous structure of biochar (pores with a diameter of around 1 mm) may be crucial for soil water retention and adsorption capability.
- Surface area determined by gas adsorption and regulated by micropores (nm scale), biochar made at low temperatures may be useful for limiting fertilizer nutrient release, but biochar made at high temperatures would result in a material similar to activated carbon.
- Although low-temperature biochar is more durable than high-temperature biochar, it is fragile and susceptible to abrade into fine fractions if put into mineral soil.

Method and Application of Biochar

- Biochar offers huge potential for enhancing crop yields and mitigating climate change. Biochar should be put near the soil surface in the root zone to improve soil fertility because this is where the bulk density of nutrient cycling and uptake by plants occurs.
- If biochar is used primarily to sequester carbon in soil, it should be buried deeper. The unique planting system must be taken into consideration when selecting how to apply charcoal to soil for agricultural purposes. On damaged soil and soil contaminated with heavy metals, organic compounds, and pesticides, biochar has the ability to aid in the development of flora.
- Biochar is a soil additive that has many soil health benefits in degraded soils because of its porous nature, which helps to retain both water and water-soluble nutrients. Biochar can help plants that demand a lot of potassium and a high pH. Biochar can cut N_2O emissions by up to 80% while also eliminating methane emissions, both of which are more potent greenhouse gases than CO_2. To induce considerable gains in plant yields, application rates of 2.5–20 tonnes per hectare (1.0–8.1 t/acre) appear to be required.
- CO_2 absorber Biochar carbon can last for centuries in the ground, while also improving water quality, increasing soil fertility, increasing agricultural

production, and reducing strain on old-growth trees. Biochar might cut worldwide net carbon dioxide (CO_2), methane, and nitrous oxide emissions by up to 1.8 billion tonnes carbon dioxide equivalent (CO_2) per year if used sustainably.

- Only 3% of the carbon from organic matter is left in the soil after slash-and-burn. Slash-and-char can keep up to 50% of its value. Biochar-enhanced soils can continue agricultural production indefinitely, whereas slash/burn soils quickly run out of nutrients, causing farmers to quit their farms and perpetuating the slash/burn cycle.
- Because to its porous nature and large specific surface area, biochar is hygroscopic. As a result, fertilizer and other nutrients are conserved for the benefit of the plants.

Biochar Production

Biochar is a fine-grained, high-carbon residue produced by pyrolysis, which is the direct thermal decomposition of biomass in the absence of oxygen (preventing combustion), yielding a mixture of solids (biochar proper), liquids (bio-oil), and gases (syngas). Pyrolysis yield is influenced by process variables such as temperature, residence time, and heating rate. More char is produced at temperatures of 400–500 °C (673–773 K). At greater temperatures, pyrolysis happens more quickly. The yield of biochar decreases as the heating rate rises. 60 percent bio-oil, 20 percent charcoal, and 20 percent syngas are typical yields. Torre faction and hydrothermal carbonization processes, in addition to pyrolysis, can thermally breakdown biomass to solid material. Because the torre faction carbon product contains some volatile organic components, its qualities are somewhere between biomass feedstock and biochar.

Centralized, decentralized, and mobile systems

Unused biomass is transferred to a central factory for processing into biochar in a centralised method. The expense of transporting liquid and solid by-products, the volume of material to be processed, and the ability to supply the power grid are all factors that impact system type selection.

Thermo-catalytic depolymerization

Microwave-assisted thermo-catalytic depolymerization has been utilised to efficiently convert organic matter to biochar on an industrial scale, yielding about 50% char.

Barriers and limitations to biochar systems

- There isn't a market for carbon credits that land managers can use to deploy biochar.
- A lack of understanding and awareness of bio-energy and carbon markets, as well as how to access them, and, in particular, how to appropriately assess the costs and benefits of using biochar in soil.
- There is currently no system in place for the carbon stored in biochar to be certified as a marketable commodity.
- The use of biochar in soil has substantial organisational and institutional challenges. Because biochar could be utilised on a wide scale and cannot be removed from soil once applied, the possible negative effects on occupational health, environmental pollution, water quality, and food safety must be carefully assessed.
- The lack of mechanistic knowledge of biochar's function and interaction with already complicated soil processes.