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Biochar – A valuable soil amendment

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Introduction:

Soil deterioration is a problem that has been around for a long time. In changing climate conditions, organic matter and soil nutrient losses pose a threat to agricultural production's long-term viability. The organic carbon content of Indian soils is deficient. Soil fertility is diminishing leading to a decline of soil organic carbon, that leads to a drop in agricultural productivity. The use of organic matter and manure in the soil can improve the organic carbon content of the soil. Biochar is an organic material that is used as a soil amendment to improve soil fertility and health.

The term "biochar" refers to charred organic matter that is used as a soil amendment. Biochar is produced by a thermo-chemical decomposition process called pyrolysis, which consists of heating biomass at high temperature (>350–600° C) in little or no oxygen conditions. Biochar is a porous carbonaceous solid made from the thermo-chemical transformation of biomass materials in an oxygen-depleted atmosphere, having physiochemical properties that make it ideal for carbon storage in the environment and soil improvement. Depending on the temperature and biomass utilised during the pyrolysis process, the proportions and properties of biochar might vary substantially.

What is Biochar?

Biochar is a material produced from organic biomass burning which generates black ash, labile carbon, and recalcitrant carbon, which are the core elements of biochar. Biochar is a global pioneer which has emerged in conjunction with soil management, carbon confiscation or sequestration issues, and pollutant neutralization. Biochar provides a bunch of potential for combating climate change and improving soil equality in order to meet basic security for succeeding generations.

Biochar differs from charcoal and other comparable materials in that it is made with the purpose of being applied to soil to improve soil productivity, carbon storage, and possibly filtering of percolating soil water. Biochar can be distinguished based on its manufacturing process and purpose. When burnt organic matter is applied to soil in a planned manner with the goal of improving soil qualities, it is referred to as biochar. This separates biochar from charcoal.

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Properties of biochar:

Biochar is a light-weight, extremely porous carbon-rich material with a fraction that has a chemical structure that resists degradation. Biochar has an alkaline pH and is typically low in available nutrients, though it does contain some ash, which adds nutrients. Depending on the features of the initial organic matter (feedstock) and the pyrolysis parameters employed for manufacture, different biochars have distinct specific characteristics. Due to variances in carbon concentration at the start, a wood-derived biochar will contain a higher proportion of carbon than a manure-derived biochar. As a result of the higher nutritional content in manure, a manure biochar will have more ashes than a wood biochar.

Biochar - Tool to Combat Climate Change:

Carbon in biochar is resistant to deterioration and can be used to store carbon in soils for extended time periods. Pyrolysis or gasification – processes that heat biomass in the absence (or under reduction) of oxygen - yield biochar. Sustainable biochar techniques can yield oil and gas byproducts that can be used as fuel, offering clean, renewable energy in addition to soil enhancement. When biochar is being used as a soil enhancer and buried in the ground, the system might turn "carbon negative". By replacing fossil fuel consumption and sequestering carbon instable soil carbon pools, biochar and bioenergy co-production can help combat global climate change. It may also help to reduce nitrous oxide emissions.

Benefits of biochar:

1. Promote plant growth. Assist in the improvement of both good and problematic nutrient-deficient soils.
2. Contribute to the reduction of greenhouse gases associated with agricultural development. Help compensate for greenhouse gas emissions associated with agricultural development.
3. Store recalcitrant form of carbon in soil.
4. Decrease the amount of fertilizer, manure, and compost requirement. Reduce the cost of treating sewage and animal waste, as well as the emissions that would otherwise be produced unless they were kept in lagoons or heaps.
5. Biochar has the ability to improve soil moisture retention, enhance crop resilience, and support intensive sustainable agriculture, thereby lowering the need for new forest clearances even while improving biodiversity conservation benefits.
6. Biochar application increases nutrient affinity, or even the retention of plant nutrients, particularly nitrogen, on permeable soils under wet conditions. Biochar has the potential to aid bioremediation by binding agrochemicals and reducing phosphate, nitrate, and agrochemical contamination in streams and groundwater.
7. Encourage biofuel production in reducing carbon footprints and possibly progress toward carbon neutrality.

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8. Increase microbial biomass in the soil and provide habitat for other beneficial organisms such as earthworms. Increase the fixation of nitrogen. Increase the number of arbuscular mycorrhizal fungi in the soil.

Soil Properties	Results
Fertilizer Use Efficiency	25 % increase
Cation exchange capacity	50 % increase
Biological Nitrogen fixation	55 % increase
Soil moisture retention	15 % increase
Mycorrhizal fungi	40 % increase
Methane emission	10 % decrease
Nitrous oxide emissions	50 % decrease