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Important and benefits of biochar in agriculture productivity and sustaining soil health

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INTRODUCTION

Soil health is the foundation of a vigorous and sustainable food system. As the land is farmed, the agricultural process disturbs the natural soil systems including nutrient cycling and the release and uptake of nutrients. Efficient use of biomass, available as crop residues and other farm wastes, by converting it to a useful source of soil amendment/nutrients is one way to manage soil health and fertility. Biochar is a potential soil amendment and carbon sequestration medium. It also reduces farm waste and improve the soil quality. Biochar is a fine-grained, carbon-rich, porous product remaining after plant biomass has been subjected to thermo-chemical conversion process (pyrolysis) at temperatures ~350–600°C in an environment with little or no oxygen. Biochar is a pyrolized biomass and also called as black gold of agriculture. It enhances plant growth which absorbs more CO_2 from the atmosphere and used as a soil amendment.

IMPORTANT FEEDSTOCKS FOR BIOCHAR

Feedstocks used at a commercial scale include wood waste, crop residues (including straw, nut shells and rice hulls), switch grass, bagasse from the sugarcane industry, chicken litter, dairy manure, sewage sludge and paper sludge

Types of feedstock-

(i) Woody biomass: Woody biomass essentially includes tree residues and forestry residues. The attributes of wood biomass are low dampness, low debris, high density and calorific value.

(ii) Non-woody biomass: Non-woody biomass comprises animal waste, industrial and agricultural solid wastes. The attributes of non woody biomass are high debris, high dampness, low density and calorific value.

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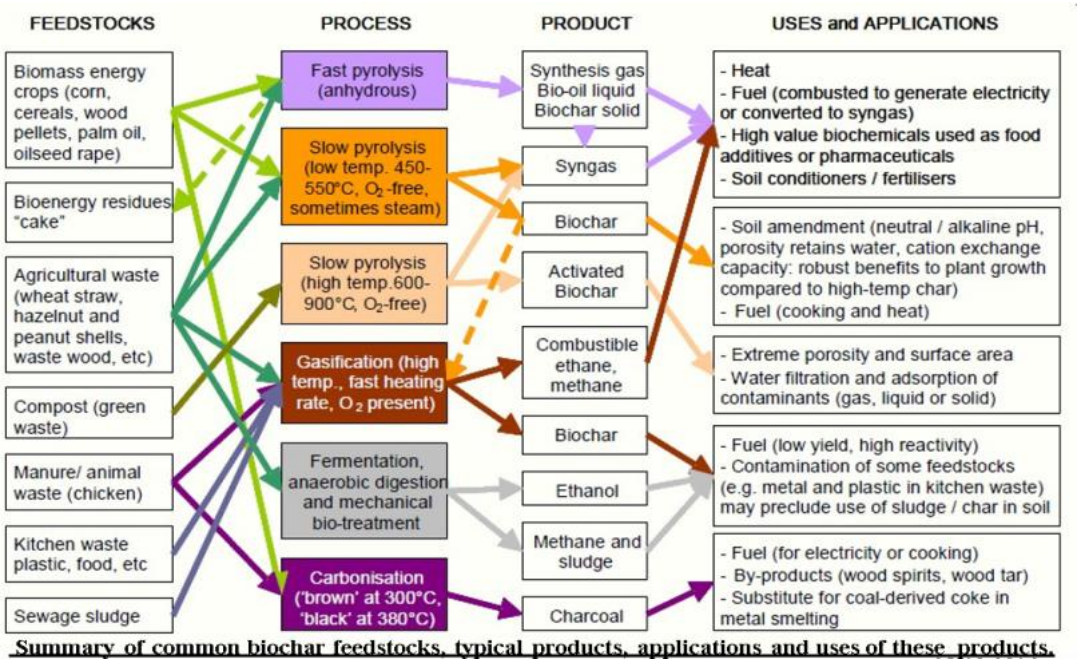
PRE-TREATMENT OF BIOMASS

Pre-treating the biomass before pyrolysis influences biochar characteristics. The common pre-treatment methods available are immersing the raw materials in solution and particle size reduction of biomass. The reduction of biomass particle size results in high biochar yield. For example, pine wood biomass was pre-treated by immersing the biomass in a dilute acidic solution. Pre-treatment methods such as nitrogen and metal doping can influence biochar production and solution pre-treatment such as soaking or steaming can influence the elemental composition and properties of biochar while the baking method can increase the carbon content and reduce the oxygen and moisture content of biochar.



Summary of common biochar feedstocks, typical products, applications and uses of these products.

EFFECTS OF BIOCHAR ON SOIL HEALTH

1. **Influence of biochar on soil physical properties:** Soil physical parameters such as wettability of soil, water infiltration, water retention, macro-aggregation and soil stability are critical importance in tropical environments in combating erosion, mitigating drought and nutrient loss and in general to enhance groundwater quality.
2. **Influence of biochar on soil chemical properties:** Observed significant changes in soil quality, including pH increase, organic carbon and exchangeable cations were observed at higher rates of biochar application.
3. **Influence on nutrient use efficiency:** Longer-term benefits of biochar application on nutrient availability mainly due to a greater stabilization of organic matter, concurrent slower nutrient release from added organic matter and better retention of all cations due to a greater cation exchange capacity.
4. **Influence of biochar on soil microbial activity:** Biochar provides a suitable habitat for a large and diverse group of soil microorganisms. Symbiosis between effective microbes and plant root through the medium of charcoal, that promotes the growth of plants.

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METHODS OF BIOCHAR APPLICATION

BENEFITS OF BIOCHAR

- ✓ Soil enhancement that lasts a lifetime
- ✓ Enhanced plant growth
- ✓ Increases soil water holding capacity
- ✓ Increases cation exchange capacity
- ✓ Supports soil microbial life and biodiversity
- ✓ Helps plants resist diseases and pathogens
- ✓ Stimulated symbiotic nitrogen fixation in legumes
- ✓ Reduces soil acidity: Raises soil pH increased soil aggregation due to increased fungal hyphae
- ✓ Reduced leaching of nutrients