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BIOCHAR APPLICATION IN AGRICULTURE UNLOCKING SUSTAINABLE POTENTIAL

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INTRODUCTION

The word “biochar” is derive from a Greek word, the “bios” meaning life and “char” abbreviated from the word charcoal. Basically, biochar is a homemade charcoal. Throwing organic matter into an oven and burn it, but the secret is to not let much oxygen in. The temperature for producing biochar ranges from 400-500 degree Celsius. It is essential to maintain these temperature ranges to ensure the desired outcome of the process. Biochar is a biomass derived charcoal produced from various organic materials and biosolids such as agricultural waste, forestry residues, manure and animal waste, green and food waste, algae. Biochar works like magic on plant and soil health, it not only improves the soil health by conditioning it but also increases crop productivity and maintains environmental sustainability.

PROPERTIES OF BIOCHAR

The properties of biochar varies with the different feedstock sources used and pyrolysis conditions. (**Tomczyk *et al*. 2020).** In general, wood biochar has comparatively high total C, low ash content, low total N, P, K, S, Ca, Mg, Al, Na, and Cu content, low potential cation exchange capacity and exchangeable cations than manure based biochar. This is due to chemical differences between the feedstocks and different physical structure at the microscopic scale of different plant material. Biochar properties can also affected by the characteristics of the parameters and equipment such as temperature, heating rates, holding time, off- gasses, use of steam and physical handling systems. As a result of all these variables, biochar properties can vary widely.

Some physiochemical properties of biochar includes:

- Chemical properties of biochar include high pH, high carbon sequestration, high nutrient exchange, high -OH, -COO, -CO, -R-OH groups, liming of acidic soils, proton activity, electrical conductivity[EC], cation exchange capacity [CEC], Anion exchange capacity[AEC].
- Physical properties includes its high surface area , high porosity , high surface charge , high water holding capacity , soil structure and nutrient

sorption and contamination mobility , microbial interaction.

- In general , biochar has different other properties such as high complexation Cd, Pb, Cu, As, Cr etc, high metal reduction and immobilization, climate change mitigation , better oxygen level and moisture level , better soil heath and agricultural yield, microbial abundance and slow nutrients release .

In general, all these properties helps to make biochar a better option to overcome many agricultural problems.

BENEFITS OF BIOCHAR IN AGRICULTURE

- **Improves soil:-** Biochar is a natural fertilizer that enhances soil nutrients and prevents them from leaching, promotes soil health by retaining soluble nutrients , helps remediation of soil suffering from heavy metal pollution and helps in decreasing soil acidity .
- **Increases agricultural productivity:-** Biochar application in crop fields helps in increasing agricultural productivity and resilience.
- **Water retention:-** Biochar helps to improve soil texture and porosity of soil which improves soil water holding capacity which ultimately helps in reducing leaching of nutrients . Provides better nourishment to plants .
- **Better activity of soil microbes:-** During unfavorable conditions, biochar improves soil's water holding capacity which provides nutrients to micro-organisms living in the soil to colonize, grow and reproduce .
- **Better alternative for chemical fertilizer:-** Terra preta is biochar enrich black soil which helps in improving physical, chemical and biological properties of soil. Biochar is a better alternative which can replace many of the chemical fertilizer in the market . It work efficiently on plants and soil to improve crop yield without damaging the environment.

- **Livestock feed additives:-** Biochar is considered as a potential solution for improving the sustainability of livestock farming . As biochar helps to reduce methane gas emission from animal excreta by improving their digestion and absorption of nutrients in body when added in diet.
- **Affordable for farmers:-** Biochar is an affordable option in the market for farmers to replaced expensive fertilizers . It works better than expensive fertilizers , biochar mixed with livestock litter and applied in fields can give wonderful results.

BENEFITS OF BIOCHAR ON ENVIRONMENT

- **Carbon sequestration:-** The process of decomposition of biomass in biochar formation is very slow and leads to the emission of certain amount of carbon and methane but carbon content release is relatively stable and remains in the soil for many years . Therefore, biochar offers climate and greenhouse gases mitigation by proper storage of carbon . Thus, Biochar is a novel solution for combating the problem of environment and food security . (Chamoli 2023)
- **Wastewater treatment:-** Biochar has a special absorbent quality which makes it a good option to work as a filterate medium to treat wastewater . It absorb various type of impurities such as heavy metal, inorganic and organic pollutant and other contaminants and makes biochar a sustainable and inexpensive option for wastewater treatment .
- **Reduced N_2O and CH_4 emissions:-** Biochar can reduce emissions of nitrous oxide and methane , two potent greenhouse gases from agricultural soils.

APPLICATION METHODS OF BIOCHAR

Biochar is organic product obtained from the pyrolysis of organic materials which is found to improve the quality of soil and quantity of crop yield. It also helps in improving physical and chemical properties of soil as well as enhances carbon sequestration which is released into the atmosphere through the decomposition of organic residues. However, there are different methods used to apply biochar in order to optimize the benefits of biochar use for agricultural production.

Several methods of biochar application include broadcast and incorporation banding, spot and ring and furrow.

- **Broadcast and incorporation: -** Even and uniform spreading of biochar by hand over the entire surface of field while cultivation or after the seed is sown in standing crop termed as broadcasting. It requires less time and comparatively less Laboure However, most of the biochar using farmers reported to date have used the broadcast and incorporation method of application.
- **Banding:** - Banding is the application of biochar in a narrow row at seeding depth or slightly deeper. In this, biochar is placed in bands which may be continuous or discontinuous to the side of seedling, some distances away from it and either at level with the seed.
- **Spot and ring:** -Sprinkling biochar in a ring around each plant in proportion to its size and rooting area will provide nutrients in a more concentration area, reducing waste between row or plants. The ring method is ideal for young trees.
- **Furrow: -** In furrow application has been commonly used in small grains to apply biochar . Biochar are applied in a open furrow at plow sole level while plowing, it is also known as plow sole placement . Such furrows are covered immediately during the next run of the plow .

CONCLUSION

Biochar has been applied to solve the problem of contaminated agricultural soil and improve soil fertility. Therefore, in agricultural sector introduction of biochar is best to overcome any biotic stress. Properties of biochar such as high carbon sequestration, more water retention , high nutrient exchange ,etc makes it a highly

promising option for pollutant removal, enhance productivity and soil improvement. Additionally, it helps to reduce greenhouse gas emissions in the atmosphere and the global warming is prevented. Biochar can be produced from different sources such as agricultural wastes, forestry residues, manure and animal waste, green waste, algae, poultry litter etc . All these organic matter get decomposed at high temperature and all the gases such as carbon dioxide , methane and nitrous oxide get stored properly in soil in stable form which reduces emission of these gases in atmosphere. But biochar which cannot be mixed into the desired soil depth, may be harmful to the environment and human health , and may causes fires , especially in high temperature regions .Hence, biochar is an novel option to bring revolution in organic agriculture with minimal investment and more benefits.

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