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Biochar - How to Improve Soil Fertility for Crop Production

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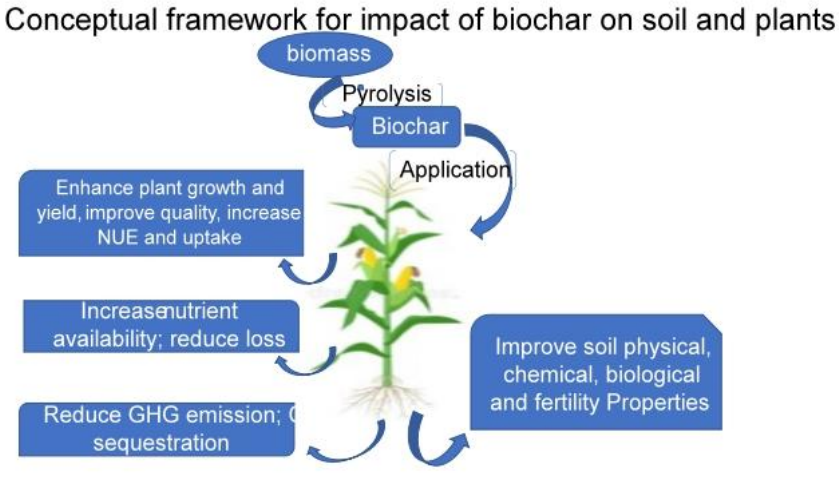
Introduction:

Biochar is a carbon rich material it is produced by thermal decomposition of organic resources under limited oxygen supply, the material converts into deep porous black it is known as Biochar, this process commonly called as "pyrolysis". Burning carbon rich material turns in to ash which elements are present such as calcium, magnesium, carbonates etc. biochar holding the very efficient plant nutrient such as nitrogen, phosphorus, potassium, and present in other plant nutrients produced from manures/waste biochar and crop residues and woody biochar.



Biochar is a anthropogenic in nature it improves the nutrient retention capacity of soil which depends on soil porosity and surface charge and also improve the soil water holding capacity and bulk density are decreases, higher surface area it has better CEC, biochar neutral

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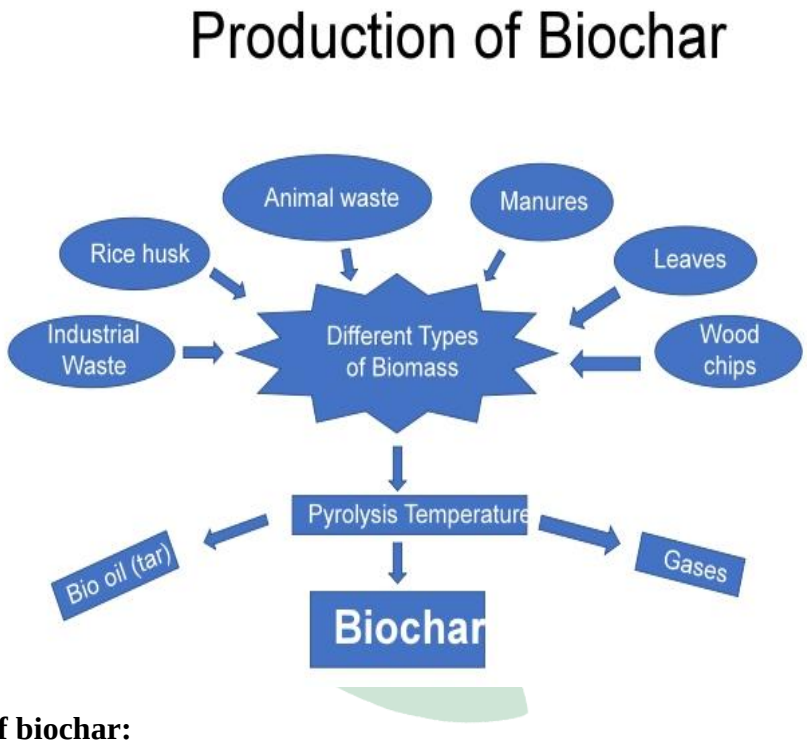
to alkaline in nature, mostly biochar increase the soil pH which positively correlated with pyrolysis temperature, aggregate stability and long terms effect on soil fertility. Biochar also turns soil biological properties by increasing microbial population, soil respiration, enzyme activity and microbial biomass. Biochar also increases nutrient use efficiency and nutrient uptake. Activated charcoals are used as an absorbent of agrochemical residues. Biochar reduces of GHG emission and c sequestration.

Production of biochar

Biochar can be prepare from a range of biomass which produced thermochemical and physical decomposition of organic materials under limited oxygen supply, the material converts in to deep porous black it is known as Biochar, this process commonly called as "pyrolysis". Biomass like as organic waste such as manures, compost, leaf litters, crop residues and woody materials, sugarcane residues, sewage and sludge etc.



Application of biochar:

Biochar incorporated combined with compost/manures or its own to the upper most of the soil and homogeneously mixed by tillage operation, biochar lighter in weight, activated charcoal present in fine dust form which are uses to absorbent of agrochemicals residues, biochar always better to keep in the root zone. This method is known as deep-banding.

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Biochar to improve soil properties

It's to improve soil physical, chemical, biological and also increase the fertility properties of the soil. In physical properties improve hydraulic characteristics, aggregate stability and improve soil structure and texture, increase soil porosity and reduce bulk density, it is to improve the nutrient retention capacity of the soil which depends upon surface charge. In chemical properties, increase soil pH, CEC and nutrient content, reduces heavy metals concentration. In biological and fertility properties, increase microbial population, Biochar increases the microbial population such as bacteria, fungi, actinomycetes, and microbial activity, enzymatic activity in to the soil microbial population can change nutrient in available form, which uptake plant nutrient for enhance plant growth and yield, biochar increases NUE and uptake of plants nutrients increase availability of nutrient and improve quality.

Nutrient sources

Biochar is an important environmental friendly source of plant nutrient such as N, P, K, Ca, Mg, S and some trace elements. The nutrient content and pH are positively correlated with pyrolysis temperature, Biochar increases the soil fertility and productivity and also increases the nitrogen retention capacity in the soil by reducing leaching and gaseous losses, and also increases the availability of phosphorus through decreases the leaching process in to the soil however potassium and others elements.

Nitrogen

In Indian soil generally deficient nitrogen, It is primary nutrient for development of plant growth and productivity, nitrogen decreases with pyrolytic temperature, in the biochar

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nitrogen present in inorganic form such as NH4+_N, No3-_N, and N2o_N (Liu et al.2019). In biochar nitrogen not present in all ionic forms, nitrogen content is high in few biomass such as sewage sludge (6.8%), Grass waste (4.9%), poultry litter (5.85%).

Phosphorus

Phosphorus is a macro nutrient its uptake by plants in large quantity, In biochar phosphorus content present varies from 0.005-5.9%, it is positively correlated with pyrolytic temperature such as increases the pyrolytic temperature increase the phosphorus content and decreases the pyrolytic temperature decrease the phosphorus content. Phosphorus content present in biochar example- chicken manures 2.96%, Poultry litter 2.57% , rice husk 0.15%.

Potassium

Potassium is primary or macro elements. In biochar depend upon pyrolytic temperature and varies from feedstock for example-rice husk, poultry litter, chicken manures etc. Rice husk 8.5 g/kg exchangeable K, corn cob 6.05 g/kg soluble K content.

Secondary nutrients

Ca, Mg and S is a secondary nutrient. In biochar depend upon pyrolytic temperature and varies from feedstock for example Which present in Woody materials, crop residues, forest residues etc. secondary nutrients are require in plant growth and fertility. Sulphur content in woody biochar ranges from 0.001-0.32%.

Trace elements/Micro nutrients

Micro elements are necessary for plant growth and productivity, its uptake by plants in small quantity (less than 1ppm). In biochar some micro elements are present such as B, Cu, Mn, Fe, Zn etc. Mostly published literature reports only Cu, Fe and Zn content present in biochar. Few literature reports B and Mo. It is present in animal manures biochar.

Table 1: Quantity of nutrients g/kg in crop residues/feed stocks

Material	P	K	Ca	Mg
Wheat straw	0.21	2.90	7.70	4.30
Maize cob	0.45	9.40	0.18	1.70
Maize stalk	2.10	0.03	4.70	5.90
Rice straw	0.20	2.3	6.9	4.7
Forest residues	-	-	130	19

Benefits of Biochar

- Provide nutrient for soil fertility and crop productivity

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- Enhance soil structure, electrical conductivity and soil aggregates
- Improving soil porosity and water holding capacity of the soil
- Improving microbial properties and nutrient holding capacity
- Neutralizing acidic soil and reducing nitrous oxide emissions
- Enhance crop Yield and productivity, improve quality
- Reduces GHG emission and carbon sequestration in the soil

Conclusion

Biochar improve the soil fertility and crop productivity, it is an important sources of plant nutrient that can supply of primary, secondary and micro nutrients to the plants. Application of biochar in to soil, good result of physical, chemical, biological and fertility properties of the soil and good soil health and aggregates. Biochar also minimize the GHG emission by carbon sequestration in the soil. Biochar is recommended and benefit to agriculture.