Science Observer

Sci. Observ. Volume 2 [5-6] 2014: 01-02
ISSN 2321-8746
http://scienceobserver.weebly.com/

BIOCHAR AS SOIL CONDITIONER

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Biochar is a carbonaceous material from the pyrolysis of biomass. The application of biochar to soil is a significant long-term sink of atmospheric carbon dioxide in terrestrial ecosystems. The role of biochar in carbon sequestration in reducing the emission of greenhouse gases, and improving soil fertility led to the recommendation of biochar as an amendment of soils. In addition, biochar offers a simple, sustainable tool for managing agricultural and urban wastes by turning it into valuable products. Incorporation of biochar in soil can exert both short and long term effect on its health. Short term benefits include a liming effect for soils with low pH and long term effects include increased nutrients and water retention capacity of soil that can affect the crop productivity.

Biochar as conservator

Fertilizers applied early in the growing season, before the crop canopy closes and field operations are no longer feasible. Applied fertilizer can be leached out of the soil by excess rainfall, consumed by weeds, or metabolized by microbial activity in the soil. Biochar helps conserve plant nutrients by storing them within its matrix and making the nutrients available when crop needs.

Value-added benefits of biochar

- carbon sequestration by the natural process of photosynthesis
- reduction of N2O-CH4 emissions from soils
- net production of energy in form of bioenergy
- increase in soil fertility and yields of agricultural crops
- increase in microbial activity in the soil
- improvement of water retention capacity in the soil
- improvement of cation exchange capacity in the soil
- improvement of durability of soil aggregates and reduction of erosion
- reduction in need of fertilization
- reduction of nutrient leaching

Highly porous internal structure act as soil conditioning agent can increase soil water holding capacity, lower bulk density, change the pore size distribution, and potentially enhance the availability to plants on medium by reducing soil strength and nutrient leaching. These benefits eventually improve the nutrient use efficiency as well as crop growth.

Biochar application as soil conditioner

The purpose of applying biochar to soil mainly falls into four broad categories:

- Agricultural profitability;
- Management of pollution and eutrophication risk to the environment;
- Restoration of degraded land and
- Sequestration of C from the atmosphere.

Agricultural profitability

Soil acidity, improvements to soil by Cation exchange capacity (CEC) and pH, water-holding capacity, and improved habitat for beneficial soil microbes are the primary causes of productivity improvements. Improved profitability requires costs of improvement to be sufficiently lower than the value of the improved productivity.

Managing eutrophication

Eutrophication is global environmental degradation. Leachable nutrients and pesticides from soil to reduce eutrophication and pollution risks in adjacent water bodies, as well as to reduce the need for fertilizer application that would be required to compensate for such nutrient losses. Biochar adsorbs nutrients phosphate and ammonium that cause eutrophication, and by adsorbing pesticides before they enter local water sources.

Biochar near the soil's surface

Biochar within the root zone is required for the interception of nutrients leached to lower soil depths, and deeper application may be desirable. Nutrients transported by overland flow may require biochar application close to the surface in buffer zones around water bodies at risk in order to maximize contact between runoff and biochar.

Re-vegetation of degraded land

Re-vegetation efforts for degraded lands by biochar acts as a carrier for beneficial soil microorganisms, for improved CEC, soil aggregation and water-holding capacity.

Application rate of biochar

A Biochar application rate depends upon soil types and crops. Biochar application on crop yields with rates of 5-50 tonnes of biochar per hectare, with appropriate nutrient management.

Frequency of application

Biochar recalcitrance to decomposition in soil, single applications of biochar provides beneficial effects over several growing seasons in the field. The target application rate varies with the availability of the biochar supply, and the soil management system, amendments can be applied in increments.

Biochar application to soil management systems

Surface application - Biochar application on soil surface minimize root damage and soil compaction. Applying biochar to soil surface in the root zone improves fertility, the bulk of nutrient cycling and uptake by plants takes place.

Broadcast and incorporate -Broadcasting done by hand on Small scales, or on larger scales by using Lime/solid manure spreaders or broadcast seeders.

Traditional banding -Banding of seeds and fertilizers in mechanized agriculture, and an amendment in a narrow band, using equipment that cuts the soil open, without disturbing the entire soil surface.

Trench application-Biochar applied in trenches radiating out from the base of established trees ("radial trenching") or in holes dug at some distance from the base of the tree ("vertical mulching");

Biochar with compost-Addition of biochar and mixing with compost stimulates microbial population in the compost and thereby nutrients are built into complex organic compounds and are very close to the soil's humus.

Biochar with manure from livestock-Mixing of manures with biochar made as compost and stored for one year prior to use.

Biochar with liquid fertilizers-Mixing of liquid fertilizer with biochar within a period of 2 days to allow complete absorption of the added liquid which in turn prevents the leaching of fertilizer.