JUST AGRICULTURE
multidisciplinary e-Newsletter

Harnessing of Biochar: A Sustainable Approach for Soil Health

Abhinav Aditya Das
PG, Scholar, Department of soil science, Acharya NG Ranga, Agricultural University, Andhra Pradesh

ARTICLE ID: 19

Abstract:

The surge in the need for food and environmental concerns provide several obstacles for modern agriculture. Scientists and decision-makers are becoming more aware of biochar's potential applications in waste reduction, renewable energy, carbon sequestration, greenhouse gas emission reduction, and soil amendment. This review aims to present a fair assessment of the environmental and agronomic effects of adding biochar to soil. The dynamics of nutrients, soil pollutants, and microbial activity may all be significantly changed by applying biochar to the soil.

Introduction:

The global economy is significantly shaped by agriculture. Food security is a big problem these days. Even though agricultural methods were much improved following World War II, the world's food supply is still unable to meet demand. Furthermore, the agriculture sector still has to resolve the new problems of soil degradation, climate change, and desertification. With the world's population expected to grow by 70% by 2050, satisfying the need for food without sacrificing the agroecosystem and soil health has become a major concern for the agricultural industry. It has become commonplace to use pesticides, fertilizers, and plant growth regulators carelessly in order to fulfill the urgent demand for food. Because of its detrimental effects on the ecology and the entire food chain, their over usage is a major reason for worry. Threats to the sustainability of agricultural production in tropical regions include the loss of soil nutrients and organic matter, a decrease in agricultural output brought on by the overuse of chemical fertilizers, and anthropogenic climate change.

Effect of biochar on soil health

The uses for biochar are many and include metallurgical processes, building materials, medicinal uses, heat and electricity generation, flue gas purification, and agricultural and animal husbandry. In an effort to lower greenhouse gas emissions, it has become more and

JUST AGRICULTURE
multidisciplinary e-Newsletter

more popular in recent years as a substitute for fossil carbon carriers in a number of these applications.

1. **Biochar as a soil amendment:** Because of its biological origin and direct application to soils with minimal pre-treatment, organic materials like biochar may be a popular alternative in this situation. The two qualities that set biochar amendment apart from other organic materials are its high capacity to retain nutrients and its high stability against decay, which allows it to remain in soil for extended periods of time and offer long-term benefits. By raising the soil's pH, cation-exchange capacity, moisture-holding capacity, and microbial flora, biochar amendments also significantly improve the quality of the soil. Phosphorus and total nitrogen concentrations have been found to rise along with the availability of basic cations when biochar is added to the soil.
2. **Biochar as soil conditioner**: Since the treatment enhances the environment for plant development, resulting in a higher yield, the use of carbonization products for soil amelioration appears advantageous from an agricultural perspective. Furthermore, adding biochar to soil raises the concentration of carbon as well as other biogenic elements including nitrogen, phosphorous, potassium, and magnesium. Biochar aids in nitrogen storage by boosting NH3 and NH4 + retention, decreasing N2O emissions and eluting NO3 ions, and promoting the growth of nitrogen bacteria, all of which have a direct impact on the rise in soil productivity.
3. **Improving soil for crop production:** When it comes to restoring soil fertility, biochar is thought to be quite successful. Numerous studies have demonstrated that applying biochar increases soil production. Because biochar may be persistent in soils for about two to three years, its exceptional qualities and advantages extend beyond the region that was disturbed to harvest biomass for the production of bioenergy. It is evident from this that applying biochar to lands that are not utilized for the production of bioenergy will improve soil fertility and lessen soil contamination from inorganic pollutants.
4. **Nutrient availability in soils:** Applying biochar raises the pH of the soil, which improves the availability of potassium and phosphorus. An oxidation process is seen on the particle surface when biochar is added to the soil. The oxidation of aromatic carbon, which results in the production of carboxyl groups, is the cause of the observed high CEC. The nutrients will stay affixed to the soil in opposition to the leaching

JUST AGRICULTURE
multidisciplinary e-Newsletter

process as CEC rises. The surface will have a negative charge when highly oxidized organic matter is adhered to it.

5. **Stimulation of soil microflora and plant growth:** Although the relationship between biochar and soil microorganisms is a complicated phenomenon, biochar offers a good home for a wide variety of soil microorganisms. The growth and yield of Vigna radiata and Glycine max plants were enhanced by the addition of biochar and phosphate-solubilizing fungal strains; these results were superior to those obtained when the strains and biochar were employed independently or as a control. The use of biochar was observed to boost Phaseolus vulgaris's biological N2 fixation (BNF), mostly because it increased the micronutrients' availability. Additionally, it has been shown that applying biochar decreased the amount of NH4 + that leached, increasing its availability for plant uptake.

Conclusion:

The loss of agricultural land caused by an ever-growing population must be stopped by using sustainable crop production methods. An appealing and cost-effective substitute method for managing and getting rid of these extra agricultural leftovers that are now being used inefficiently is the thermochemical process of gradual pyrolysis, which turns them into biochar. One of the greatest ways to combat biotic and abiotic stressors, such heavy metal toxicity, acidity, nutrient depletion, etc., and boost crop output is to add biochar to the soil. Applying biochar as a soil conditioner has several advantages from an agricultural perspective, including improving the physical, chemical, and biological characteristics of soils, which raises crop yields.

References:

DeLuca TH, Gundale MJ, MacKenzie MD, Jones DL (2015) Biochar effects on soil nutrient transformations. Biochar for environmental management: science, technology and implementation 2:421-454.

Kiran YK, Barkat A, Cui XQ, Ying FE, Pan FS, Lin TA, Yang XE (2017) Cow manure and cow manurederived biochar application as a soil amendment for reducing cadmium availability and accumulation by Brassica chinensis L. in acidic red soil. Journal of Integrative Agriculture 16(3):725-734.

Kavitha B, Reddy PV, Kim B, Lee SS, Pandey SK, Kim KH (2018) Benefits and limitations of biochar amendment in agricultural soils: A review. Journal of environmental management 227:146-154.

Mensah AK, Frimpong KA (2018) Biochar and/or compost applications improve soil properties, growth, and yield of maize grown in acidic rainforest and coastal savannah soils in Ghana. International Journal of Agronomy 1:1-8.

Zhang M, Cheng G, Feng H, Sun B, Zhao Y, Chen H, Chen J, Dyck M, Wang X, Zhang J, Zhang A (2017) Effects of straw and biochar amendments on aggregate stability, soil organic carbon, and enzyme activities in the Loess Plateau, China. Environmental Science and Pollution Research 24(11):10108- 10120. https:// doi.org/10.1007/s11356-017-8505-8.