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Utilization of Poultry Litter Biochar as Soil Amendments

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Introduction

The idea behind poultry litter biochar (PLB) is for more efficient management of available resources, minimization of nutrients loss through different mechanism like volitization of NH_3, surface run off etc., towards eco-friendly and more sustainable approach of farming. Generally, poultry litter/waste is directly applied as organic manure but this has various adverse impact and with advancement in technology and science, poultry waste can be put to more good use. With the global poultry industry experiencing significant growth, driven by increasing demand for high-quality protein, rising consumer awareness of health benefits, and evolving dietary preferences [11], the quantity of poultry waste/litter generated also goes up. Indian poultry sector alone produces around 3.30 million tonnes of waste annually [1] and 20,000 tons of poultry manure is generated globally for every 100,000 birds with an average weight of 1.81 kg per bird [12], poultry litter is good source of organic fertilizer available easily. The potential of PLB as soil amendments is studied and researched by different scholars and researchers. Findings of different researchers shows high potentiality of PLB as soil amendment.

Why Poultry litter biochar?

- **Availability of Poultry litter:** Poultry litter are easily available in every poultry farming as, it is basically the waste products in combination with other waste components of the poultry house or farm**.** The major components of poultry litter (PL) include the bedding material, feather, manure and the spilt feed [2]. Soil fertility is solely based on the availability of soil nutrients therefore the nutrients present in the PL will improve the fertility and quality of the soil. The litter contains nutrient, such as N, P and K, trace elements, such as Cu, Zn and As, pesticide residues, pharmaceuticals

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such as coccidiostats, endocrine disruptors and microorganisms [2]. PL has a good amount of nutrients and is considered a good source of organic fertilizer but mismanagement and improper application of PL leads to certain problems [3]. The production of Biochar from PL is a new management approach that can be considered as a safer and more effective alternative to utilize this resource in agriculture [3].

- **More efficiency as Biochar:** Biochar is produced from intentionally heating a biomass feedstock via pyrolysis or gasification, typically in an oxygen limited environment, with the goal of creating a stable, carbon-rich product resistant to degradation in soils [4]. It is a charcoal-like substance that is made from agricultural and forestry wastes (also called biomass) in a controlled process [5].Biochars produced from different biomass materials and with different pyrolysis conditions (e.g., temperatures) present highly heterogeneous physicochemical properties, which can affect the efficacy in the remediation of contaminated soils [3].Poultry litter biochar (PLB) is produced from fresh PL heated at 300 °C temperature for 10 min in muffle furnace [7]. It is a value-adding soil amendment and an economically sustainable approach that is used to enhance food safety and reduce environmental harm [8]. PLB helps to retain nutrients and provide nutrients for a long time by slow release than that of PL, besides, the pyrolysis temperature makes it pathogen free [3]. After pyrolysis of PL, the many of the essential nutrients, (N, P, K, Ca) required for plant growth and alsoelectric conductivity and organic carbon in PLB increased [7, 3], making PLB more productive and efficient than PL.Though PL contains good amount of nutrients, when apply directly to soil as manure, certain problems including nutrient leaching, soil acidification, over-application of P results in eutrophication, emission of different harmful gases like ammonia, health hazards, environmental pollution and also fresh PL is a reservoir of different pathogen [3]. It is clear that PLB undoubtedly can be evaluated as a promising organic fertilizer with high nutrient content and has considerable influence on plant growth than that of fresh PL for sustainable agriculture [7].
- **PLB helps in soil amendments:** Reclamation of soil has always been an important solution for maintaining soil pH and reclamation of problematic soil like acid, acid-sulphate, saline, sodic, submerged soil etc and biochars can be utilized to reclaim this

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problematic soils. Biochars produced from different biomass materials and with different pyrolysis conditions (e.g., temperatures) present highly heterogeneous physicochemical properties, which can affect the efficacy in the remediation of contaminated soils [9]. Soil amendment are used to improve the quality of soil and biochar has been shown to improve the soil quality and stabilize heavy metals [8] The organic carbon composition in the PLB also helps in improving the quality of the soil. The conversion of PL to biochar increased nutrients availability, it can be used for correction of deficiency of certain nutrients in soil. The pH of soil can be increased by addition of PLB and pH is increase by the addition of basic biochar as it enhanced the immobilization of heavy metals [10]. Biochar can conceivably reduce the bioavailability and efficacy of both heavy metal and organic pollutants in soil [6]. The high specific surface areas and micro-porosity make biochar very efficient sorbents for a range of organic compounds [9] hence reduce the bioavailability organic pollutants in soil.

Conclusion

PLB has high potential to be the way forward for eco-friendly and sustainable agriculture. The great amount of poultry waste generated worldwide annually could make this a possibility. Direct application of poultry litter has many adverse impacts, to mitigate this, proper poultry waste management practices are essential, production of Biochar from poultry waste is one way. Biochar, carbon-rich residue derived from the pyrolysis of biomass stands at the intersection of sustainability, agriculture, and environmental stewardship. Various research shows PLB as a promising tool in addressing pressing challenges such as soil degradationand agricultural productivity enhancement. The available nutrients content of PL is increased by conversing it in to Biochar, hence more efficient and productive than direct application of PL. Also, the organic carbon content also increased thus applying of PLB improves not only fertility but physical properties like structure. The study on PLB as soil amendments, the positive impact it had and also its impact in the long run is still underway, severalgaps has been identified by different scholars and further research is required to fill this gap.

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