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QUANTIFICATION OF BIOCHAR-INDUCED CHANGES ON SOIL PROPERTIES AND MICROBIAL DIVERSITY: A META-ANALYSIS

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ABSTRACT: **Biochar is a widely known soil amendment to improve soil health, sequester carbon, and enhance plant growth. In this study, we conducted a meta-analysis to synthesize the available information on the impact of biochar application on different soil properties. We collected data on the effects of biochar application on different physical, chemical, and microbial soil properties from relevant literature and statistically analysed by using the statistical software SPSS version 28. Based on selection criteria, total 805 data entries from 57 studies from the literature published between 2013 and 2022 were selected for the meta-analysis. The application of biochar resulted in an increase in soil pH, cation exchange capacity and organic carbon, with greater effects observed in soils with coarse and fine textures. However, the effects on chemical properties varied depending on the type of feedstock used to produce the biochar. Among physical properties, biochar application reduced bulk densities and increased porosity. Biochar prepared at higher pyrolytic temperatures (>500°C) improved bulk density and porosity to greater extent. Biochar prepared at lower pyrolytic temperatures (<500°C) had a greater effect on microbial diversity (both bacterial and fungal), with more diverse bacterial populations in medium and coarse textured soils, while fungal diversity increased in fine textured soils. The meta-analysis emphasized the necessity of carrying out extended field experiments to elucidate the changes in biochar properties as it undergoes aging, its prolonged impacts on soil properties, and the optimal timing for re-applying various types of biochar.**

Keywords: *Biochar, meta analysis, microbial diversity, soil properties*

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INTRODUCTION

The utilization of biochar as a soil amendment has been increased due to its ability to sequester carbon, reduce greenhouse gas emissions, enhance soil quality, and boost crop yields (Koide *et al*., 2014; Mukherjee and Lal, 2013). Biochar, defined as a stable and carbon-rich substance formed through the pyrolysis (heating in the absence of oxygen) of organic or bio-based materials (Chan *et al*., 2008; Woolf *et al*., 2010), can be derived from various sources including organic and industrial wastes (e.g., sludges,