

Abstract

Biochar is a porous, carbon-rich material derived from the thermochemical decomposition of biomass materials. Biochars are suitable soil amendments that enhance soil properties and improve crop productivity. Biochar agronomic impact in soils depends on its physiochemical properties. Recent research has shown that feedstock type and pyrolysis temperature are the key factors influencing biochar physiochemical properties. However, an in-depth understanding of the biochar-soil-plant co-relationship governing biochar agronomic performance still needs improvement. A comprehensive overview of the effect of biomass and pyrolysis temperature on biochar properties, mechanisms governing biochar-soil interactions impact on agronomic indices, the long-term effect of biochar, and the viability of large-scale biochar agricultural systems have been discussed. The mechanisms governing the impact of temperature and biomass properties on biochar agronomic properties are different for low temperature (<500 °C) and high temperature (>500 °C). The agronomic benefits of biochar are dependent on biochar-soil-plant interaction mechanisms. The economic and financial feasibility of large-scale production of biochar is case-specific and makes business sense when all co-pyrolysis products are recovered and sold. Understanding biochar-soil-plant-climate interaction mechanisms is key to designing biochars to address specific agronomic needs and requires an interdisciplinary and multiscale approach. Future studies should focus on long-term co-relationships among biochar physiochemical properties, soil conditions, climate, and farm management.