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Pelleted biochar: Chemical and physical properties show potential use as a substrate in container nurseries

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ABSTRACT

We found that peat moss, amended with various ratios of pellets comprised of equal proportions of biochar and wood flour, generally had chemical and physical properties suitable for service as a substrate during nursery production of plants. High ratios of pellets to peat (>50%) may be less desirable because of high C:N, high bulk density, swelling associated with water absorption, and low volumetric water content, whereas a mixture of 75% peat and 25% pellets had enhanced hydraulic conductivity and greater water availability at lower (<−10 kPa) matric potentials. Adding pellets to substrates used to grow plants in nurseries has potential to add value to biochar and thereby improve economic viability of pyrolysis. Moreover, biochar-amended substrates offer opportunity to sequester carbon as part of the normal outplanting process.

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1. Introduction

Pyrolysis is the process of heating a biomass feedstock rapidly in the absence of oxygen, and then quickly condensing the resultant vapors into bio-oil, the desired product [1]. The residue is biochar, a granular, carbon-rich substance. Its particulate form reduces microbial decomposition so biochar persists in the environment. Intuitively, generating the highest-value target products and adding value to residual products are both essential for sustainable biomass conversion to energy [2,3]; adding value to residual biochar would improve the overall economic efficiency of pyrolysis.

Biochar has potential value. It can be used to filter pyrolysis exhaust gases [4], serve as base product for production of nitrogen fertilizer [5], be treated with steam to generate activated carbon [6], and has been suggested as a farm fertilizer [4,7] and as a way to improve forest productivity [8]. As a soil amendment, biochar can increase water-holding capacity, reduce bulk density, provide additional cation exchange sites, and serve as a source of reduced carbon compounds that may benefit microbial populations [7,9–13], all of which promote plant growth.

These potential benefits to plant growth may be leveraged in the nursery production of plants, particularly for those grown in small volume (<500 ml) containers for reforestation and ecosystem restoration [14]. Unfortunately, chemical and physical properties of substrates in containers, which are primarily organic in nature and influenced by the dynamics of the containers themselves, behave much differently than mineral soils found on farms and in forests [14]. Although

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