Composting as a way to convert cellulosic biomass and organic waste into high-value soil amendments: A review

COMPOSTING AS A WAY TO CONVERT CELLULOSIC BIOMASS AND ORGANIC WASTE INTO HIGH-VALUE SOIL AMENDMENTS: A REVIEW

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Abstract

Plant-derived cellulosic materials play a critical role when organic wastes are composted to produce a beneficial amendment for topsoil. This review article considers publications dealing with the science of composting, emphasizing ways in which the cellulosic and lignin components of the composted material influence both the process and the product. Cellulose has been described as a main source of energy to drive the biological transformations and the consequent temperature rise and chemical changes that are associated with composting. Lignin can be viewed as a main starting material for the formation of humus, the recalcitrant organic matter that provides the water-holding, ion exchange, and bulking capabilities that can contribute greatly to soil health and productivity. Lignocellulosic materials also contribute to air permeability, bulking, and water retention during the composting process. Critical variables for successful composting include the ratio of carbon to nitrogen, the nature of the cellulosic component, particle size, bed size and format, moisture, pH, aeration, temperature, and time. Composting can help to address solid waste problems and provides a sustainable way to enhance soil fertility.

Keywords

Composting; Soil; Cellulosic biomass; Biodegradation; Carbon; Nitrogen; Humus; Odor control; Recalcitrance; Aeration; Bacterial succession

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 Municipal Solid Waste consists of more than 40 percent of organic waste, so composting most of this waste would be the best way to reduce the quantity to one fourth resulting in nutrient rich soil amendment. Recovering the energy value embedded in waste prior to final disposal is considered preferable to direct landfilling assuming pollution control requirements and costs are adequately addressed. Whereas pyrolysis converts the solid wastes into solid, liquid and gas products, gasification converts organic materials into a syngas (CO and H 2). The effect of pyrolysis to the environment is loss of biodiversity, desertification and emission of acid and green-house gases. Composting is seen as a key process in the waste hierarchy and has an important role When used as a soil amendment, biochar has been reported to boost soil fertility and improve soil quality by raising soil pH, increasing moisture holding capacity, attracting more beneficial fungi and microbes, improving cation exchange capacity (CEC), and retaining nutrients in soil (Lehmann et al., 2006; Lehmann, 2007). Furthermore, soils containing biochar have a strong affinity for organic contaminants (Yang and Sheng, 2003a; 2003b; Yu et al., 2009). Sustainable agriculture is a way of raising food that is healthy for consumers and animals without causing damage to ecosystem health. Low nutrient content and accelerated mineralization of soil organic matter (SOM) are the two major constraints currently encountered in sustainable agriculture (Renner, 2007). Composting as a way to convert cellulosic biomass and organic waste into high-value soil amendments: A review. MA Hubbe, M Nazhad, C Sánchez. BioResources 5 (4), 2808-2854, 2010. 1. Effect of salt concentration during streaming current titrations with strong poly-acid and poly … J Chen, JA Heitmann, MA Hubbe. Colloids and Surfaces A: Physicochemical and Engineering Aspects 223 (1-3 …, 2003. 124. 2003. Control of tacky deposits on paper machines–A review. MA Hubbe, OJ Rojas, RA Venditti. Nordic Pulp & Paper Research Journal 21 (2), 154-171, 2006. URLs: bioresourcesjournal.com; http://ncsu.edu/bioresources ISSN: 1930-2126

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