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## Sustainable recycling of waste biomasses as soil amendment in agriculture- Traditional and novel applications

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Recycling the large amounts of organic wastes and residues produced by urban, agriculture, forestry and industrial activities as soil organic amendment is the most popular and efficient option for avoiding their dispersion in the environment and restoring, maintaining, and/or improving the content of soil organic matter. However, because of the several adverse effects organic wastes in the "fresh" or "raw" state may produce in soil, these materials are rarely applied to soil directly. Chemical stability and biological maturity are two important factors for the efficient use of organic wastes in agriculture with limited risk for the surrounding environment. Stabilization and maturation of raw organic wastes can be achieved by applying various types of pretreatments, among which the most efficient and commonly used is composting with the final production of compost. Any pretreatment inherently implies the achievement of an extensive humification, that is, a wide conversion of easily degradable organic matter to refractory organic compounds that resemble native soil humic substances (HS). Soil HS are the most important components of soil organic matter responsible of several soil functions and processes. As a consequence, the amount and quality of HS-like fractions in any organic amendment are of primary importance for its agronomic efficacy, environmental safety and economic value. The first part of this review focuses on some general aspects of the composting process and technology to produce the compost. The second part discusses the main compositional, structural and functional chemical and physico-chemical properties of HS-like fractions in compost and the effects of its application on native soil HS with increasing time after application. The third part presents some representative data on a novel promising property and application of compost as containing natural organic nanoparticles able to absorb organic contaminants such as polycyclic aromatic hydrocarbons (PAHs).

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