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Perspective

Effect of Composting and Amendments on Soil Biostabilisation

Marie Rumpel*

Department of Ecology and Environmental Sciences, University of Paris-Saclay, Thiverval-Grignon, France

DESCRIPTION

Human activities have the potential to lead to undesirable environmental change with the possibility of crossing and having unpredictable implications on several planet boundaries in 2050, when the population is projected to be close to 10 billion. A wide range of environmental laws and normative documents have been produced in Europe over the past few decades with the goal of preserving nature and preventing human activities from straying outside of these biophysical bounds. Sustainable methods for converting organic wastes into organic additions, such as potting medium or soil conditioners, include composting and vermicomposting. However, the drawbacks of these procedures include the release of greenhouse gases, odorous molecules, and the probable presence of hazardous substances in the finished product. By adding organic, inorganic, or biological ingredients to the composted or vermicomposed mixture, these detrimental effects can be reduced.

The definition of composting is a bio-oxidative process that results in the mineralization and transformation of organic materials. The finished product is regarded as stable and pathogen- and phytotoxic agent-free. Three stages are commonly involved in composting: initial activation, thermophilic phase, and maturation phase. Simple organic molecules like sugars are mineralized by microbial communities during the initial activation, which typically lasts 1-3 days. This process generates CO_2, NH_3, organic acids, and heat. The composting pile's temperature rises during this stage. The temperature then reaches its peak during the thermophilic phase. Pathogens can be killed above 55 °C at temperatures between 40°C and 65°C, which is the ideal range for composting. Thermophilic bacteria break down lignin, cellulose, and lipids at this stage. The temperature gradually drops throughout the mesophilic phase or maturation as a result of decreased microbial activity brought on by a reduction in biodegradable chemicals. Depending on the temperature of the composting pile, a succession of microbial communities is involved in composting. For example, fungi are absent at temperatures higher than 60°C, where bacteria are more prevalent. Therefore, temperature and the relative abundance of particular microbes are reliable markers of the compost's evolution.

Depending on the type of worm being used, vermicomposting takes place at temperatures between 25°C and 37°C. Higher or lower temperatures typically have a negative impact on the activity and growth of worms. In large quantities, vermicomposting facilities use four species. Two of them are tropical species, and two are temperate. These species are known as epigeic worms and are comparable to worms that primarily consume compost, manure, and other types of fresh organic materials. Similar to composting, verticomposting emits greenhouse gases. Worm activity speeds up and improves the decomposition of organic waste, producing more CO_2 emissions than conventional composting. Compared to composting, the emissions of N_2O are higher or lower, most likely dependent on the input components.

A wide range of additives, grouped into three types (mineral, organic, or biological), may be employed to improve the quality of the finished compost or the composting and vermicomposting processes. Microorganisms that are added to a compost or vermicompost pile are referred to as biological additives. Typically, during the thermophilic phase, these bacteria are separated from composts, grown, and marketed as a commercial product. Vertical transmission bacteria and efficient microorganisms are frequent commercial additives. Only a few producers disclose the names, fates, and purposes of the microorganisms found in commercial solutions. Grass clippings, mature composts, refuse from green waste compost screening, crushed hardwood materials, crushed wood pallets, bark, and cornstalks are just a few examples of the wide range of things that fall under the category of organic additives. To ensure organic matter breakdown and stop N leaching during composting, consideration must be given to the original mixes' C/N ratio when selecting organic additions. Additionally, biochar, a pyrolysis product with a high aromatic content, has recently attracted a lot of attention as a highly stable organic component for composting and vermicomposting. Because adding biochar to soil has been demonstrated to produce highly fragrant compounds with great stability, biochar may increase the capacity of composts and vermicomposts to store carbon, hence reducing climate change.

Correspondence to: Marie Rumpel, Department of Ecology and Environmental Sciences, University of Paris-Saclay, Thiverval-Grignon, France, E-mail: marieram@inra.fr

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