



Mitigation of CO₂ Emissions in Agro-Ecosystems by Composting of Tree Leaf Litter with Effective Microorganisms and Green Sunnhemp Plants

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ABSTRACT

Managing leaf litter by using different composting methods may be an alternative approach to solid waste management in rural areas. The purposes of the study were to prepare compost from an admixture of tree leaf litter using effective microorganisms (EM) and green sunnhemp plants and assess the patterns and cumulative amounts of carbon dioxide (CO₂-C) emission and CO₂ mitigation potential. The N content of leaf litter from both compost methods was significantly higher. The EM-treated compost had better concentrations of microbial biomass carbon (MBC), potassium, calcium, and magnesium. The low germination and vigor index were observed in compost treated with green sunnhemp plants. The CO₂ emission patterns were similar in both leaf litter compost treatments. The composting techniques used in this study can save roughly 310 kg CO₂eq in greenhouse gas (GHG) emissions. Composting leaf litter with EM and green sunnhemp plants could be a useful technique for lowering agriculture's GHG emissions, besides helping to mitigate climate change, reducing the solid waste from rural areas, and minimizing the use of mineral fertilizer in agriculture.

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KEYWORDS

CO₂ emissions; composting technique; fruit based EM; green manuring plant; tree leaf biomass

Introduction

In an agro-ecosystem, farmers grow multipurpose trees and shrubs with annual and perennial agricultural crops in the croplands and homestead areas to fulfill the requirements for fruits, fuel wood, timber, and fodder to support their livelihoods. This tree-based farming system is an age-old and traditional land use system in rural India, contributing particularly to nutritional security, promoting recycling of plant nutrients, providing materials for livestock shelter, and having considerable environmental and ecological benefits (Singh, Gohain, and Datta 2015). In such a multi-strata agriculture system, trees and shrubs shade parts of their biomass (known as litter) in the form of leaves, twigs, fruits, bark, and small branches periodically. Most plants are deep-rooted; they absorb minerals from the soil, and a good portion of these minerals goes into the leaves. In India's rural areas, people often pile up such leaf litter or set it on fire. According to the World Bank (2018), global rural waste generation is about 3 billion tons per year (Singh et al. 2021). The large amount of leaf litter that covers the majority of the solid waste not only causes a storage issue but also causes eutrophication of water bodies through nutrient leaching. In addition to generating air pollution, burning leaf litter releases toxins into the atmosphere and causes GHG emissions (Wu et al. 2021). But if suitable waste management procedures are used, this leaf litter waste can be a good source of nutrients for the soil. When fallen tree leaves are converted into compost through several stages of decomposition into well-decomposed humus, they contain most of the essential plant nutrients for plant growth (Hilty and