



Effect of Plant Residue Incorporation on Soil Microbial Biomass Carbon and Nitrogen

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Introduction

Crop residue management enhances soil fertility by providing carbon and nitrogen. Decomposition rates and residue types impact soil enrichment. Soil microbial biomass is key for nutrient cycling and carbon storage. Akinsola et al. (2025) This study explored the effects of plant residue on soil microbial biomass and organic carbon. Plant residues are materials that are very rich in organic matter. When these materials decompose, they contribute Organic Carbon, nutrients, and other essential elements to the soil. Plant residue incorporation as a process of soil improvement was investigated on soil microbial biomass Carbon and Nitrogen.

Materials and method

A 6 x 3 factorial experiment in a Randomized Complete Block Design (243 m² with 54 plots) with three replicates was conducted at the organic farm of the Federal University of Agriculture, Abeokuta, Nigeria, to determine the effect of the following residues: maize stover, banana leaf, neem clippings, *Leucaena leucocephala*, *Panicum maximum*, and *Chromolaena odorata* at three application rates (0, 10, and 20 tonnes per hectare) on soil microbial biomass carbon and nitrogen. Plant materials at 0, 5, and 10 t/ha were decomposed for a month before maize was seeded at a 25 cm x 75 cm spacing. The plant residues used in this research were collected from different locations and were cut into smaller particles to mix thoroughly with the soil, which also plays a major role in their decomposition. The chloroform fumigation extraction method was used on the collected soil samples with decomposed plant residues, which showed that there was a significant effect of plant residues on microbial biomass carbon. However, there was no significant effect when evaluating microbial biomass nitrogen.

Results and discussion

Prior to soil analysis of the farm plots, the soil was slightly acidic (pH 6.0), which supports microorganism growth and residue decomposition. It had low organic carbon and nitrogen content, likely due to insufficient time for residue mineralization. The soil texture was classified as sandy loam. The effect of plant residues on soil microbial biomass carbon indicated that *Panicum maximum*, neem clippings, and maize stover significantly boosted microbial biomass carbon, with *Panicum maximum* showing the highest increase. *Leucaena leucocephala* had a moderate effect, while banana leaf and *Chromolaena odorata* contributed the least. The study found that applying residues at 20 t/ha significantly increased microbial carbon compared to other rates. Therefore, a 20 t/ha application rate is recommended for optimal microbial carbon support. *Panicum maximum* and maize stover showed a strong correlation between microbial and organic carbon due to their slow decomposition. In contrast, banana leaf, *Chromolaena odorata*, *Leucaena leucocephala*, and neem clippings had lower correlations.

Conclusion

Plant residues impacted soil microbial biomass carbon but not nitrogen, with low microbial biomass in the study area. *Panicum maximum*, neem clippings, and maize stover efficiently utilized microbial biomass carbon, with higher application rates improving efficiency. Further studies on plant residue incorporation are needed to understand microbial biomass carbon and nitrogen dynamics.

Keyword: Decomposition, Organic matter, Soil improvement, Soil microbial.