

# Organic material types have stronger effects on humic substances and enzyme activities than soil types

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February 20, 2022

## Abstract

Organic materials are essential to increase soil organic carbon (SOC). However, it is unclear whether C sequestration is primarily affected by the form of organic materials or soil types. Wheat straw, tobacco straw, and their derived biochars were added to acidic soil, saline soil and calcareous soil in the same C concentration and incubated for 30, 90, and 180 days, respectively. The contents of humic substances (HS), the structural characteristic of SOC, and enzyme activities were investigated. The results revealed that both biochar-C and crop straw-C were mainly sequestered in humin (HU) across all soil types. Moreover, humic acid (HA) levels increased in straw treatments but not in biochar treatments. The cluster analysis and principal components analysis showed that HU had a significantly positive correlation with SOC. The aryl C of SOC increased in biochar treatments, while phenolic C and O-alkyl C of SOC increased in straw treatments. A positive correlation was found between aromatic C and SOC concentration, as well as between polyphenol oxidase activity and O-alkyl C. The formation of O-alkyl C was affected by polyphenol oxidase activity. These findings suggest that the form of organic materials and microbial activity, rather than soil types, influence the formation of HS and functional groups of SOC. Soil amended with biochar can sequester more recalcitrant C while also increasing the hydrophobicity of SOC.

## Highlights

- 1) Straw increased phenolic C and aryl C of SOC, while biochar mainly increased much more aryl C of SOC.
- 2) Both biochar and crop straw are mainly sequestered as HU.
- 3) C sequestration in HS are not affected by soil types, but mainly affected by forms of organic materials.
- 4) There was a significantly positive correlation between polyphenol oxidase activity and O-alkyl C of SOC.

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