Science of the Total Environment 660 (2019) 1–10

Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

Labile and recalcitrant components of organic matter of a Mollisol changed with land use and plant litter management: An advanced ^{13}C NMR study

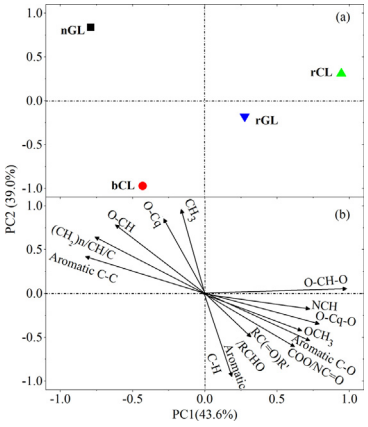
Shui-Hong Yao [a,1], Yue-Ling Zhang [a,1], Ya Han [a], Xiao-Zeng Han [b], Jing-Dong Mao [c], Bin Zhang [a,*]

[a] National Engineering Laboratory for Improving Fertility of Arable Soils, Institute of Agricultural Resources and Regional Planning, Chinese Academy of Agricultural Sciences, Beijing 100081, PR China
[b] Key Laboratory of Mollisols Agroecology, National Field Observation and Research Station of Hailun Agroecosystems, Northeast Institute of Geography and Agroecology, Chinese Academy of Sciences, Harbin 150081, PR China
[c] Department of Chemistry and Biochemistry, Old Dominion University, 4541 Hampton Blvd, Norfolk, VA 23529, USA

HIGHLIGHTS

- Restored and native grasslands were compared with croplands with straw removed and burnt
- Long-term cropping from native grassland resulted in decreases in carbohydrates and increases in lignin
- No straw burning increased lignin oxidization and reduced the size of aromatic cluster
- Labile and recalcitrant components may be protected in light and heavy fractions, respectively

GRAPHICAL ABSTRACT



ARTICLE INFO

Article history:
Received 12 November 2018
Received in revised form 26 December 2018
Accepted 26 December 2018
Available online 02 January 2019

Editor: Shuzhen Zhang

Keywords:
Soil organic matter
^{13}C NMR
Land use change
Crop straw management
Physical fractionation
Mollisol

ABSTRACT

Soil organic matter (SOM) changes with land use and soil management, yet the controlling factors over the chemical composition of SOM are not fully understood. We applied quantitative ^{13}C nuclear magnetic resonance and spectral editing techniques to measure chemical structures of SOM from different land use types. The land use types included a native grassland (nGL), a crop land with straw burning in the field (bCL), a restored grassland (rGL) and a cropland with straw removed out of the field (rCL) for 28 years. The abundances of O—CH groups from carbohydrates were higher in the SOMs of the nGL and rGL than in those of the rCL and bCL, while the abundances of OCH_3 and aromatic C—O groups from lignin were higher in the SOMs of the three-ever cultivated lands (rGL, rCL and bCL) than in that of the nGL. Although aromatic C—C groups were most dominant in the Mollisols, they did not consistently decrease after the burnings of straw were ceased in the fields of the rCL and rGL compared to the bCL with continuous burning. In addition, the COO groups were bound with the aromatic C—C groups in all the land use types, and the sizes of the aromatic clusters were affected by the land use types. The labile and recalcitrant components were correlated with SOC contents the mineral-associated and particular SOM in a contrasting way. Our results suggested that the chemical composition of SOM in the Mollisol depended

* Corresponding author.
E-mail address: zhangbin01@caas.cn (B. Zhang).
[1] The authors contribute to the work equally.

https://doi.org/10.1016/j.scitotenv.2018.12.403