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Effects of different management models on soil organic carbon of natural secondary forests of Quercus Mongolica in China

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1. Scope and Objectives

- **Objectives:**

Quercus is the largest tree species in China with great potential for carbon sequestration. The carbon storage and distribution pattern of *Quercus mongolica* natural secondary forest under different management regimes were studied in order to provide theoretical basis for carbon sink potential assessment and sustainable management of *Quercus mongolica* natural secondary forest in northeast China.

- **Experiment design:**

where: Danqinghe forest farm in Harbin, Heilongjiang，China.
What: a 63-year-old natural secondary *Quercus mongolica* forest.
when: the management experiment was carried out in 1999 and lasted for 20 years.

- **The three management models were**:

M1: no-disturbance model
M2: target tree model
M3: comprehensive tending

2. Innovative approach

- Soil samples at 0-10 cm depth were collected in August 2018 using a 10 cm diameter soil auger.
- The determination of MBC and MBN was accorded to the chloroform fumigation extraction method, and the SOC and TN was measured using an automatic TOC analyzer.
- The soil physical fractionations was analyzed by heavy liquid suspension grouping method.
- SOC chemical composition was characterized with solid-state ^{13}C NMR spectroscopy.

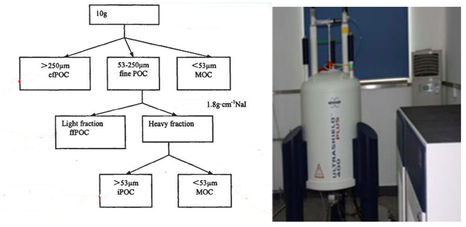

Fig. 1 The flow chart of the heavy liquid suspension grouping method (left) and the ^{13}C NMR spectroscopy.

3. Results

3.1 The content of SOC and TN

- The SOC、MBC、TN、MBN were ranked in order of no-disturbance regime > comprehensive tending regime > target tree regimes (Fig. 2).
- There was no significant difference in soil organic carbon and microbial biomass nitrogen among different management models.
- However, the MBC and the TN under comprehensive tending regime were significantly lower than that under target tree model.

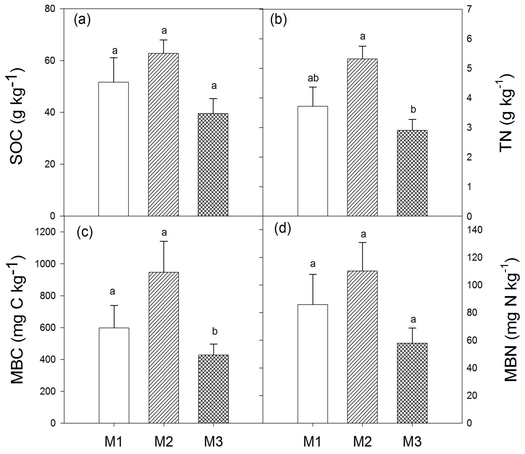

Fig. 2 Effects of different management models on soil organic carbon、 total nitrogen、microbial biomass carbon and microbial biomass nitrogen.

3.2 SOC and TN in physical fractions

- Different management models had no effect on the content of cfPOC and MOC (Fig.3).
- The target tree model and comprehensive tending model significantly reduced the content of ffPOC.
- The content of iPOC significantly increased under the target tree model.
- The impact of different management model on ffPTN is not significant.
- The contents of cfPTN, iPTN and MTN were significantly different between the target tree management and the comprehensive tending management.
- The content of SOC and TN in all physical fractions were lowest under the comprehensive tending management except ffPTN.

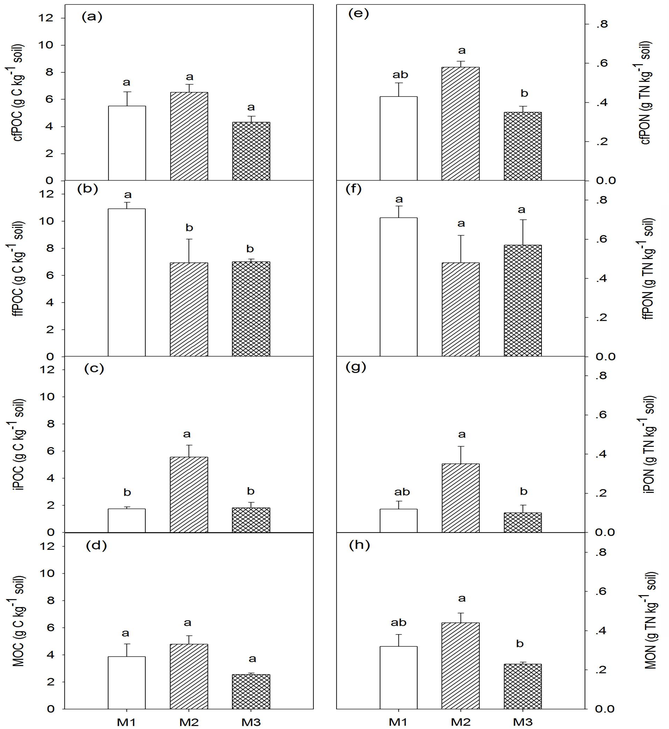

Fig. 3 Effects of different management models on soil organic carbon and total nitrogen of each soil aggregate fractions. cfPOC: the coarse free particulate organic carbon(>250 μm); ffPOC: the fine free POC(53-250 μm)；Ipoc: the intra-microaggregate POC(>53 μm); MOC: the mineral associated organic carbon fraction(<53 μm).

3.3 SOC chemical composition

- The relative proportion of the functional groups were ranked as O-alkyl C > alkyl C > aromatic C > carbonyl C (Fig.4).
- The alkyl C/O-alkyl C ratio decreased under the target trees management, while increased under comprehensive tending management.
- Both target tree management and comprehensive tending management increased the percentage content of alkyl C (with an increase of 29.45-58.91%), while decreased the percentage content of aromatic C (with a decrease of 20.86-40.46%) and carbonyl C (7.55-47.78%) .т

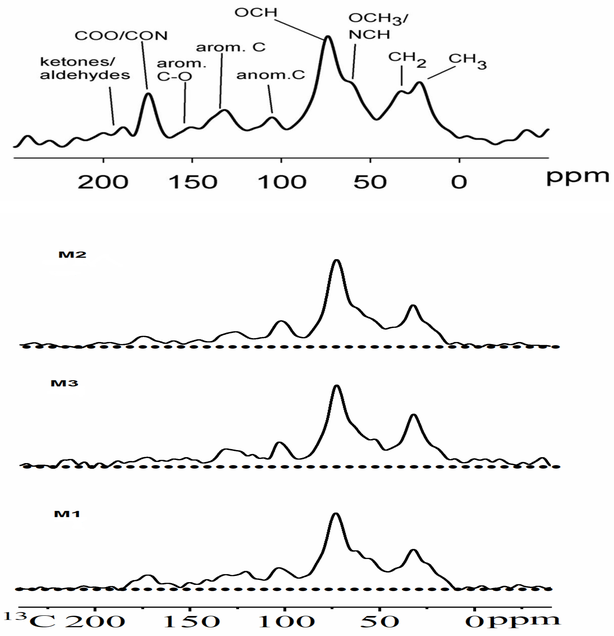

Fig. 4 Effects of different management models on soil organic carbon functional groups.

4. Conclusion

- 20 years management has no effect on the content of SOC, but has changed the biological activity, physical composition and chemical structure of SOC.
- The target tree management reduces the decomposition of organic carbon, so as to fix more carbon.
- While the comprehensive tending management accelerates the decomposition of soil organic carbon, resulting in the loss of soil carbon.
- The no-disturbance model maintains soil carbon level by aggregating catabolic macromolecular particles.
- Target tree is an ideal carbon sequestration management model.