Forest structure characteristics on soil carbon and nitrogen storage of Pinus massoniana plantations in southern subtropic region

Kexin Zhang[1,2], Dongli Gao[1,4], Hong Guo[1], Ji Zeng[3] and Xianzhao Liu[1,2]*

[1]Research Institute of Forest Resource Information Techniques, Chinese Academy of Forestry, Beijing 100091, China

[2]Key Laboratory of Forest Management and Growth Modeling, National Forestry and Grassland Administration, Beijing 100091, China

[3]Experimental Center of Tropical Forestry, Chinese Academy of Forestry, Pingxiang 532600, Guangxi, China

[4]Industry Development and Planning Institute, NFGA, Beijing 100013, China

Abstract:【Objective】Forest carbon and nitrogen storage significantly affect forest ecosystems and global carbon and nitrogen cycles. Forest management can achieve sustainable development by regulating stand structure. Therefore, the relationship between stand structure and soil carbon (SOCD) and nitrogen storage (SOND) needs in depth study. 【Method】In this study, experiments were carried out in mixed and pure Pinus massoniana forests to analyze the effects of stand density, stand age, and their interaction on the change trends in SOCD and SOND in different soil layers 【Result】The results showed that, in upper (0–20 cm), middle (20–40 cm), and lower (40–60 cm) soil layers, with increased stand density, the SOCD of pure P. massoniana stands first increased and then decreased, while SOND increased monotonically; in mixed P. massoniana stands, SOCD and SOND both increased monotonically. In different development stages (young, middle-aged, and near-mature), the average SOCD of pure P. massoniana stands were 91.31 t/ha, 88.56 t/ha, and 85.98 t/ha, respectively, while the average SOCD of mixed P. massoniana stands were 55.92 t/ha, 48.61 t/ha and 55.05 t/ha. The SOCD of pure P. massoniana stands was significantly higher than mixed P. massoniana stands at all growth and development stages. In pure P. massoniana stands, with increasing stand density, the SOCD of young, middle-aged, and near-mature stands first increased and then decreased, while the SOND increased monotonically. In the mixed P. massoniana stands, with increasing stand density, the SOCD of young, middle-aged, and near-mature stands increased monotonically, while the SOND of young stands increased initially and then decreased, while those of middle-aged and near-mature stands increased monotonically. 【Conclusion】These results emphasized that the artificial regulation of stand density at the appropriate development stage can maximize the carbon and nitrogen fixation potential of forest soil.