凋落物量对帽儿山 4 种森林土壤表面碳通量的影响

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摘要：【目的】量化凋落物量变化对森林土壤表面碳通量的贡献，揭示其影响路径。【方法】本研究以帽儿山地区 4 种典型森林为研究对象，于 2020 和 2021 年的生长季设置 6 个不同的凋落物量的梯度，测定减少和增加不同枯落物量后的土壤表面碳通量、凋落物呼吸及主要环境因子。【结果】研究结果表明：随枯落物量的增加，土壤表面碳通量呈线性增长，4 种林型下 6 个凋落物处理凋落物处理对土壤表面碳通量的影响值的范围分别为：红松人工林 0.59~7.07μmol·m^{-2}·s^{-1}、落叶松人工林-0.87~4.78μmol·m^{-2}·s^{-1}、蒙古栎人工林-0.85~24.44μmol·m^{-2}·s^{-1}、硬阔叶次生林-0.98~2.49μmol·m^{-2}·s^{-1}；单位质量的凋落物呼吸的范围分别为：红松人工林 0.012~0.034μmol·g^{-1}·s^{-1}、落叶松人工林 0.010~0.014μmol·g^{-1}·s^{-1}、蒙古栎林 0.017~0.043μmol·g^{-1}·s^{-1}、硬阔叶次生林 0.016~0.050μmol·g^{-1}·s^{-1}，阔叶林内单位质量的凋落物呼吸远高于针叶林，低凋落物下更高；针叶林凋落物对土壤呼吸均产生了一定的抑制，在八月生长季旺期的红松人工林和落叶松人工林中，相比于完全去除凋落物，保留凋落物最高使得土壤呼吸下降了 1.23 和 1.39；凋落物普遍降低了土壤 5cm 温度的波动性；在蒙古栎人工林内，凋落物量的增多显著促进了土壤表面碳通量和土壤呼吸 Q_{10} 值的提升，在 2020 年和 2021 年分别从 2.21 和 2.12 增长到了 7.16 和 3.71，其他林型中则未表现出显著规律。【结论】本研究证明了短期处理下凋落物对土壤表面碳通量的贡献主要来自凋落物自身分解呼吸，透气性差的针叶林凋落物甚至会抑制土壤呼吸；而只在阳坡的蒙古栎人工林中，凋落物才能通过改变土壤表面碳通量对温度敏感性，促进高温时土壤内部的大量碳释放。

关键词：东北森林；土壤呼吸；凋落物；Q_{10}

Effect of litter amount on soil carbon efflux of four forests in Maoershan Mountain

Abstract:【Objective】The aim of this study was to quantify the contribution of litter amount change to forest soil carbon efflux and reveal its influence path.【Method】In our study, four typical forests in Maoershan area were selected as the research objects. Six gradients of litter amount were set up during the growing seasons in 2020 and 2021, and the soil carbon efflux, litter respiration and important environmental factors were measured after different litter amount was decreased or increased.【Result】The results showed that soil carbon efflux increased linearly with the increase of litter amount, and the range of influence values of litter treatment on soil carbon efflux of 6 litter treatments under 4 forest types was as follows: Korean pine plantation was 0.59–7.07 μmol·m^{-2}·s^{-1}, larch plantation 0.87–4.78 μmol·m^{-2}·s^{-1}, Mongolian oak forest -0.85–24.44 μmol·m^{-2}·s^{-1}, hard broadleaf secondary forest - 0.98–2.49 μmol·m^{-2}·s^{-1}; The range of litter respiration per unit mass is: Korean pine plantation 0.012–0.034 μmol·g^{-1}·s^{-1}, larch plantation 0.010–0.014 μmol·g^{-1}·s^{-1}, Mongolian oak forest 0.017–0.043 μmol·g^{-1}·s^{-1}, hard broadleaf secondary forest 0.016–0.050 μmol·g^{-1}·s^{-1}, Litter respiration per unit mass in broad-leaved forest was much higher than that in coniferous forest, and higher under low litter. Litters in coniferous forest inhibited soil respiration to some extent. In Korean pine plantation and larch plantation in August growth season, litters retention decreased soil respiration by 1.23 and 1.39 compared with total litters removal. Litter generally reduced the

temperature fluctuation of soil 5cm. In the Mongolian oak forest, the increase of litter amount significantly promoted soil carbon efflux and soil respiration Q_{10} value, which increased from 2.21 and 2.12 to 7.16 and 3.71 in 2020 and 2021, respectively. There was no significant pattern in other forest types.【Conclusion】Our study proved that the contribution of litter to soil carbon efflux under short-term treatment mainly came from litter decomposition, and the litter of coniferous forest with poor air permeability even inhibited soil respiration. However, only in the Mongolian oak forest with the sunny slope, litter can promote the release of soil carbon at high temperature by changing the temperature sensitivity of soil carbon efflux.

Key words: Northeast forest; Soil respiration; Litter; Q_{10}